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"FOR BETTER SCIENCE TEACHING"

The Science Counselor

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In Future Numbers . . .

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An Introduction to Zirconium Metal

By John R. Roch, Chief Physical Metallurgy Division, Zirconium Metals Corporation of America, Niagara Falls, New York.

Temperature and Precipitation as Contributing Factors in the Maturation of Peas

By Gerald W. Ostheimer, St. Francis College, Loretto, Pennsylvania.

Odenbach Seismic Laboratory

By Angelo Lamendola, Technical Director, McQuaid Jesuit High School, Rochester, New York.

Honey

By John Stomfay-Stitz, Professor of Biology, Duquesne University, Pittsburgh 19, Pennsylvania.

Comments on Undergraduate Research Experience at King's College

By Rev. William H. Donahue, C.S.C., King's College, Wilkes-Barre, Pennsylvania.

Attempts to Induce Resistance to an Inbred Strain of Mice by Mitochondria of a Homologous Tumor

By Sister M. St. Agatha, I.H.M., Immaculata College, Immaculata, Pennsylvania.

Insect Life History

• By Sister Mary Annunciata McManus, R.S.M.
MOUNT MERCY COLLEGE, CEDAR RAPIDS, IOWA

Imagination, ingenuity, and interest are the main factors in the development of this interesting extra-curricular study of insects.

Do we sometimes excuse our lack of these qualities by pleading lack of time, space, and equipment?

The striking anatomical changes which mark the stages in the life history of most insects have always intrigued anyone with an interest in nature. Professional biologists have learned much from the study of metamorphosis, and so long as the mechanism of differentiation remains one of the most basic unsolved problems of biology, interest in these changes will undoubtedly remain high.

Students of all levels are readily fascinated by following at first hand the sequence of events in the life cycle of insects. As their observations continue, and new questions of "how" and "why" occur to them, their interest naturally fans out to include many of the great principles of biology and their interrelationships. The interests of one such group of students in our laboratory became quite diversified, but gradually centered on endocrinology and the morphology of the endocrine organs. In the attempt to find the explanation for many of their observations, they have brought together a substantial amount of the available information, and have developed a keen interest and some facility in verifying and extending this by their own efforts.

As a result of this study, which was not a part of any course work, I believe that their intellectual development has been accelerated in a number of ways. They have come to a broader understanding of the interrelationships between the various disciplines of the biological sciences, and of the similarities and the differences in biological processes in the lower phyla as compared with the higher. They have a much greater appreciation for and a clearer notion of the methods used in research, of the requirements of reliable experimental procedures, of the value of proper records, and of the type of conclusions that can validly be drawn from data obtained.

They have become interested in the general problems of the mechanisms of hormonal control, of growth and development, and of differentiation. This broadened and deepened consciousness of the large questions which are of most concern to modern biologists has quickened their interest in all areas of biology, and has provided at least some background of information for their more advanced courses.

The insect which we used was the lowly mealworm, *Tenebrio moliter* L., available in most laboratories. It has many advantages for such a study. It has complete or endopterygotus metamorphosis, so that all four stages can be studied. It presents no problem of feeding or care—our culture has been maintained for several years in the same gallon jar of bran, and the adult form does not fly, so that the culture stays where it is put.

The eggs are tiny and hard to find, and when the larvae or "mealworms" emerge they are also very small. They feed ravenously, however, and at room temperature grow and molt regularly.

Even at this stage of their life history, the students found hormones at work. They learned that both the growth of the larva and the shedding of its chitinous exoskeleton are controlled by a hormone which has been named for the shedding process: "ecdysone." The endocrine gland which secretes ecdysone is located in the prothorax, in some insects, and in these it is called the prothoracic gland. In other insects, Drosophila, for instance, the gland is located in the head. A part of the ring gland of Weismann secretes ecdysone in this second group.

Our students found that the position of the glands which secrete ecdysone in *Tenebrio* is controversial. One of the foremost investigators in this field (3) reported that he was unable to find prothoracic glands in the Coleoptera. In 1954 Stellwaag-Kitler reported finding prothoracic glands in *Tenebrio moliter* L., but Srivastava (1) believed that the structures which he found were actually salivary glands. Srivastava used vital staining, and found near the neck the structures which he believes to be the true prothoracic glands.

This lack of correspondence in the findings of the various investigators prompted our students to carry out some investigations of their own. We developed a technique for the vital staining and dissection of the larva, and one of the students has located what we believe to be the prothoracic glands. Figure 1 shows its location.

As long as ecdysone continues to be produced by the prothoracic or ring gland, the larva continues to grow and molt. When production of ecdysone stops, the insect goes into diapause, and normal growth and activity are discontinued. Diapause occurs normally in midsummer in many insects, and in winter in many, and can be produced artificially by removal of the prothoracic glands. After the period of diapause, hormone production is resumed, and development continues where it left off.

The activity of the prothoracic gland is turned on and off by a hormone which is produced in the brain by clusters of "neurosecretory cells." These cells can be distinguished even *in vivo* because of a whitish semi-opaque material which they contain. Their secretion passes downward along their axons to a plexus of axon

endings called the "corpus cardiacum." The hormone accumulates in the corpus cardiacum and from it passes into the blood.

Obviously, the mechanism just described closely resembles the activity of the neurosecretory cells of the human hypothalamus, which has only recently been clarified. The pars nervosa of the pituitary gland is now believed to be merely a storehouse for the hormones of the posterior lobe, which are produced by neurosecretory cells in the hypothalamic portion of the brain and pass down along the axons of these cells to the pars nervosa. From this highly vascular area, they enter the circulation.

The corpus cardiacum of the insect is thus seen to afford a striking parallel to a component of what has long been considered the "master gland" of the human organism. There is also similarity of function: the brain hormone of the insect controls the activity of the prothoracic gland in a manner quite reminiscent of the effect of the tropic hormones of the pituitary. Just as the adrenocorticotropic hormone of the pituitary stimulates the adrenal cortex to produce its characteristic secretion, the brain hormone of the insect acts upon the prothoracic gland to stimulate it to produce ecdysone.

Winter is the normal period of diapause, during which the neurosecretory cells of the brain are quiescent. Recovery from this inert condition seems to require that the insect experience low temperature, as it normally does during the winter. Recovery from diapause can be hastened artificially by subjection to cold.

The students tested the effects of temperature on the rate of growth and number of molts, and found that at 4° C *Tenebrio* larvae remained alive for 4 months but did not grow or molt. When removed to room temperature (about 22° C), they resumed growth and molted. Some larvae which had attained nearly maximum normal size when refrigeration was begun, passed immediately into the pupal stage when removed from refrigeration.

Continuation of the growth and periodic molting depends on the presence of another hormone which has been called the "juvenile hormone" or "neotenin." While it continues to act, the insect remains juvenile, in the larval stage, regardless of how large it becomes. Metamorphosis requires its discontinuance (4).

Neotenin is secreted by a part of the ring gland of Weismann in some insects or in others by a pair of tiny glands near the brain called the "corpora allata." The specific action of neotenin is to block metamorphosis, and so long as the corpora allata are present and functional, the insect continues to grow as a larva and does not change to the pupa and the adult form.

Much experimental work has been done to test the effects of this juvenile hormone. If the corpora allata are removed from very small larvae, they go immediately into the pupal stage and then metamorphose to midget adults. If neotenin is injected into larvae which have reached the stage at which metamorphosis would normally occur, they continue to grow and molt but do not pass into the pupal stage. This can be continued for some time, and when neotenin injection is discontinued, the pupal stage follows and giant adults emerge.

We have good evidence, therefore, for at least three hormones which control the life stages of insects: the hormone of the neurosecretory cells of the brain, ecdysone, and neotenin. The neurosecretory cell hormone stimulates the prothoracic gland to secrete ecdysone, which acts upon the tissues of the body to cause growth and ecdysis. These two processes continue for as long as there is an adequate supply of the third hormone, neotenin, from the corpora allata. When neotenin is no longer produced, both processes stop, and the insect passes into a new stage of development.

There is thus an interlocking series of processes which control metamorphosis, but where is the cycle initiated? There must be some message which stimulates the neurosecretory cells of the brain to begin secretion. Wigglesworth (2) has found that in Rhodnius, the kissing bug, distention of the abdomen after a blood meal will produce a molt. This might indicate that the brain has received a message that raw material for growth is now available, so that the rigid case which prevents enlargement must be shed.

Feeding, as is well known, is the life work of the larva. A striking feature of larval anatomy is the fat body, in which food is stored. To us it seems not improbable that when the food supply accumulated in the fat body is sufficient to support the tremendous metabolic activity required for the reorganization which the insect undergoes in the pupal stage in preparation for entry into adult life, a sensory stimulus from the abdominal region should notify the brain. The normal response to this stimulus would be cessation of neotenin production, and metamorphosis to the pupal stage.

Ecdysis is easily observed in *Tenebrio*, and is fascinating to watch. The larvae usually crawl to the top of the bran, and often put on a lively performance in extricating themselves from the exoskeleton. They may lie on their sides and kick their feet until it is shed, and if temperature or humidity are not optimum,

(*Continued on Page 92*)

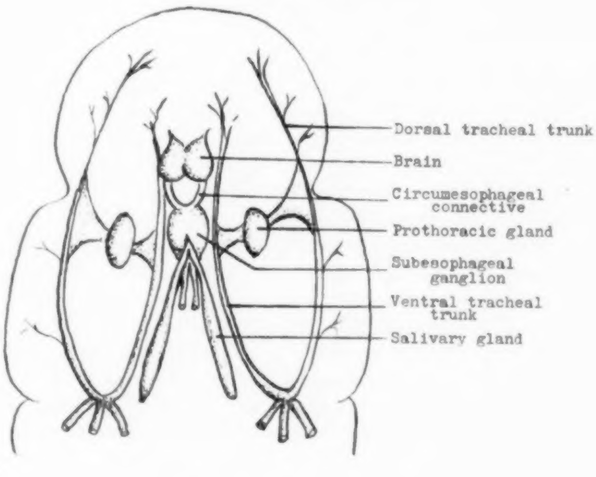

Fig. 1. Diagram showing location of prothoracic gland in Tenebrio molitor L. Dorsal view, schematized.

Pharmacy Panel

REPORT TO THE REGIONAL COMMISSION ON EDUCATIONAL COORDINATION PITTSBURGH, PENNSYLVANIA

Starting in September, 1960, colleges of pharmacy will start a five year program. In 1959, a Pittsburgh Regional Commission was formed to study the problem of co-ordinating pharmaceutical and secondary education.

The participating members of the Commission were:

Joseph P. Buckley, Professor of Pharmacology, University of Pittsburgh

Sherick Gilbert, Mt. Lebanon High School, Mt. Lebanon, Pa.

Miss Rose Hartz, Taylor Allderdice High School, Pittsburgh, Pa.

Kenneth Liska, Assistant Professor of Pharmaceutical Chemistry, Duquesne University

Bernard J. McCormick, Principal, Taylor Allderdice High School, Pittsburgh, Pa.

Joseph D. McEvila, Associate Professor of Pharmacy Administration, University of Pittsburgh

David S. Mooney, Associate Professor of Chemistry, Washington and Jefferson College.

Martin Nicklas, Assistant Principal, Jefferson Junior High School, Mt. Lebanon, Pa.

John Ruggiero, Assistant Professor of Pharmacy, Duquesne University

Charles F. Sebesta, Associate Professor of Mathematics, Duquesne University

Reuben Slesinger, Professor of Economics, University of Pittsburgh

I General Statement

Pharmacy is essentially a professional practice involving a broad knowledge of biology, chemistry, and mathematics. While the practitioner is basically a scientist he is also a business man and an administrator. He must therefore not only be educated in the natural sciences but must also be competent in the social sciences and humanities. The student who desires to enter the field of pharmacy should complete a high school curriculum which will permit him to enter a school of liberal arts. He should have an established interest in mathematics, biology, and chemistry, and possess a knowledge of the world in which he lives. The student, at the high school level, should have mastered the skills of both oral and written communications. His college curriculum should permit him to use these skills in developing a style of transmitting information. As a pharmacist he will be required to transmit knowledge of a technical nature not only to colleagues in pharmacy and the allied health professions but also to the general public. He must possess the ability to communicate on a level in keeping with the knowledge of the various publics with which he maintains contact.

The future of the health professions in general and of pharmacy in particular will not be under the sole control of the members of the profession. Government, corporations, unions, and other associations which help to mold public opinion will take increased action in determining the role pharmacy will play in the next two or three decades. The practicing pharmacist of the future, for professional reasons as well for the reason that he must be a well informed citizen, must be competent in social and economic affairs. The pharmacist must be able to work with and through the various organizations of a public and semi-public nature as well as the professional organizations of which he is a part.

One of the major problems of the high school is to identify the student who has the motivation and the capacity to pursue the necessary educational requirements leading to a professional degree. However, mere recognition is not enough; the high school must provide a curriculum which will stimulate the student to develop to his maximum potential. The prospective college student is entitled to and must receive continuing guidance from the moment he is either identified or makes known his desires.

This committee, following considerable discussion, felt the following problems to be of major importance at all levels of education but had a particular relevance to the professional school and deemed they be considered for further study:

1. Develop communication skills.
2. Increase the student's ability to recognize and understand principles.
3. Develop the student's ability to analyze and solve mathematical problems of a pharmaceutical nature.

II Development of Communications Skills

After initial discussion, it was apparent that the problem of communications is not only an important skill in the practice of pharmacy but is a major importance regardless of one's ultimate endeavor. The modern pharmacist must not only be able to read and interpret the literature of his field but must be able to understand and analyze the broader literature appearing in daily newspapers. This information then has to be transmitted to members of the other health professions as well as to the members of the community he serves. He should be able to prepare and deliver papers of a scientific-professional nature on a plane equal to the various publics he serves—professional, scientific, and general. The pharmacist because of his unique position is in daily contact with the public. This contact involves answering questions concerning the health of individuals, as well as those of a public health and sanitation nature. His education should enable him to disseminate this vital information as well as to use good judgment in deciding what should and should not be discussed openly with the general public. He should be able to read, interpret, and discuss ques-

tions having a socio-economic relationship with the health professions.

The proper indoctrination of a student should follow a basic pattern as he progresses through his educational program. The secondary schools should be concerned primarily with providing the student with the tools necessary for communication. The colleges should provide the student with opportunities to apply these tools under conditions which may be encountered in every-day life. At the college level, time should be provided, for the student to express himself properly. He should not be buried beneath a bushel of facts which may leave no room for self-expression but should be encouraged and permitted to express his thoughts in creative writing. Minutiae of the pharmaceutical sciences can best be taught at the professional level where the student can make use of the tools and know-how in utilizing nomenclature peculiar to pharmacy.

One of the reasons offered for decreasing skill in communication is the excessive use of the objective type of examination. This type of test has merit in evaluating a student's ability to recognize and associate facts but does not permit self-expression. We must give the student every opportunity to participate actively in his own educational experience and certainly examinations are ever present opportunities.

Theme writing and the opportunity for individual participation are necessary, especially at the secondary school level. Cooperation between the English and science departments in the preparation of technical papers resulting from individual research projects is recommended.

Those students who show rapid development in the area of oral or written communications should not be forced to wait for the others to catch up but should be provided with advanced sessions or classes.

III Ability to Understand Basic Principles

Pharmacy is a dynamic, ever-changing profession which demands that the practitioner continue his education after graduation. In most cases, this must be accomplished by self-education which means that he must have not only the proper background but the motivation to continue his studies. The panel members believe that unfortunately a significant percentage of students graduating from all levels of education do so on their ability to memorize isolated facts rather than on their command over the basic principles of the material presented to them.

There appear to be many components influencing the student to learn by rote rather than to comprehend the underlying principles involved.

One of the contributing factors at all levels of education is the student's concern for high marks. There is little doubt that this concern is currently over-emphasized. Although in many cases the origin of such emphasis may be traced to the home or community, pressures resulting in mark consciousness are exerted by secondary schools, colleges, and professional schools. Eventually the student becomes more concerned with receiving a high mark *per se* than with the academic mastery represented by it. The attainment of high marks thus becomes a major aspect of the student's educational process.

It is recognized that a de-emphasis of marks in the secondary schools will be difficult. However, through the placement of students possessing high aptitude in specific academic areas in "advanced classes," there should be a more wholesome academic atmosphere and a greater desire for learning. In some schools students so selected are guaranteed at least a "B" mark and remain in these classes as long as they continue to demonstrate high achievement.

While emphasis on marks *per se* should be minimized to any degree possible, the establishment of proper study habits should receive more attention from all who are concerned with the student's welfare. Learning how to study and the formation of productive study habits should be considered as a developmental process beginning in early childhood and continuing through adult life. This process involves not only the teacher but parents as well. Learning how to listen, to pay attention, to follow directions, to start and finish a little job or game, and to do other seemingly insignificant preschool child tasks, might well be the conditioning basis for the development of proper study habits at a later date.

Courses should be designed so that there is enthusiasm on the part of the teacher and student. The student should be exposed to a flexible and dynamic rather than a fixed type of program. The teacher should stimulate the student's interest in the course work so that the knowledge obtained will go beyond that discussed in class. The pre-professional years of articulation between high school and the professional school should consolidate and enlarge the student's knowledge of Mathematics, English, Humanities, the social sciences, and the general sciences. The professional school should present the unique preparation necessary for pharmacy.

Even at the secondary school level the teacher should explain the relationship of course material to the ultimate objective of the course. Wherever possible the knowledge acquired in the process of learning should be put to some functional use to stimulate a desire for understanding and questioning.

Examinations should be designed so that they require genuine thinking on the part of the student and examine him on his total academic skills and not on the memorization of selected material. Admittedly this is a difficult task in secondary schools because of the large number of students each teacher is responsible for, however this can be employed at the college and professional levels.

This study group felt that there were increased pressures on the secondary schools by the colleges to include more material in the basic courses than had been taught in the past and that the colleges were also asking for better prepared students. A major problem, at the present time, is that the secondary schools must provide for a heterogenous group, whose members differ widely in both interest and ability. Instruction of these students is made more difficult because many of them

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The Analytical Nose . . . The Story of an Electronic "Sniffer"

• By Robert E. Zange, B.S. (University of Pittsburgh)
PITTSBURGH, PENNSYLVANIA

In December, 1955 we published an article "The Mass Spectrometer in Science and Industry" by Arthur Gifford. The author of this article discusses some of the developments that have taken place since 1955.

One of the most intelligent "noses" in existence today can be found in a prominent Pittsburgh laboratory. Like most human noses, this one can tell the difference between formaldehyde and alcohol. But *unlike* any human nose, it can tell the difference between odorless gasses like methane and ethane, because when these gasses hit the "olfactory circuit" of this electronic sniffer, things begin to happen!

This analytical nose is in reality a near-$50,000 instrument known as a Mass Spectrometer. It is employed by the lab to analyze mixtures of hydrocarbons in their research work on synthetic gasoline. To the uninitiated, this Mass Spectrometer looks like a telephone switchboard, a chemistry set, a Christmas tree, and a television set turned inside out.

Exactly *what* takes place inside the multitude of vacuum tubes, resistors, condensers and dials, may easily be understood by an analogy: Think of a sample of hydrocarbon molecules as ranks of "H" 's (for Hydrogen) and "C" 's (for Carbon), all joining hands as

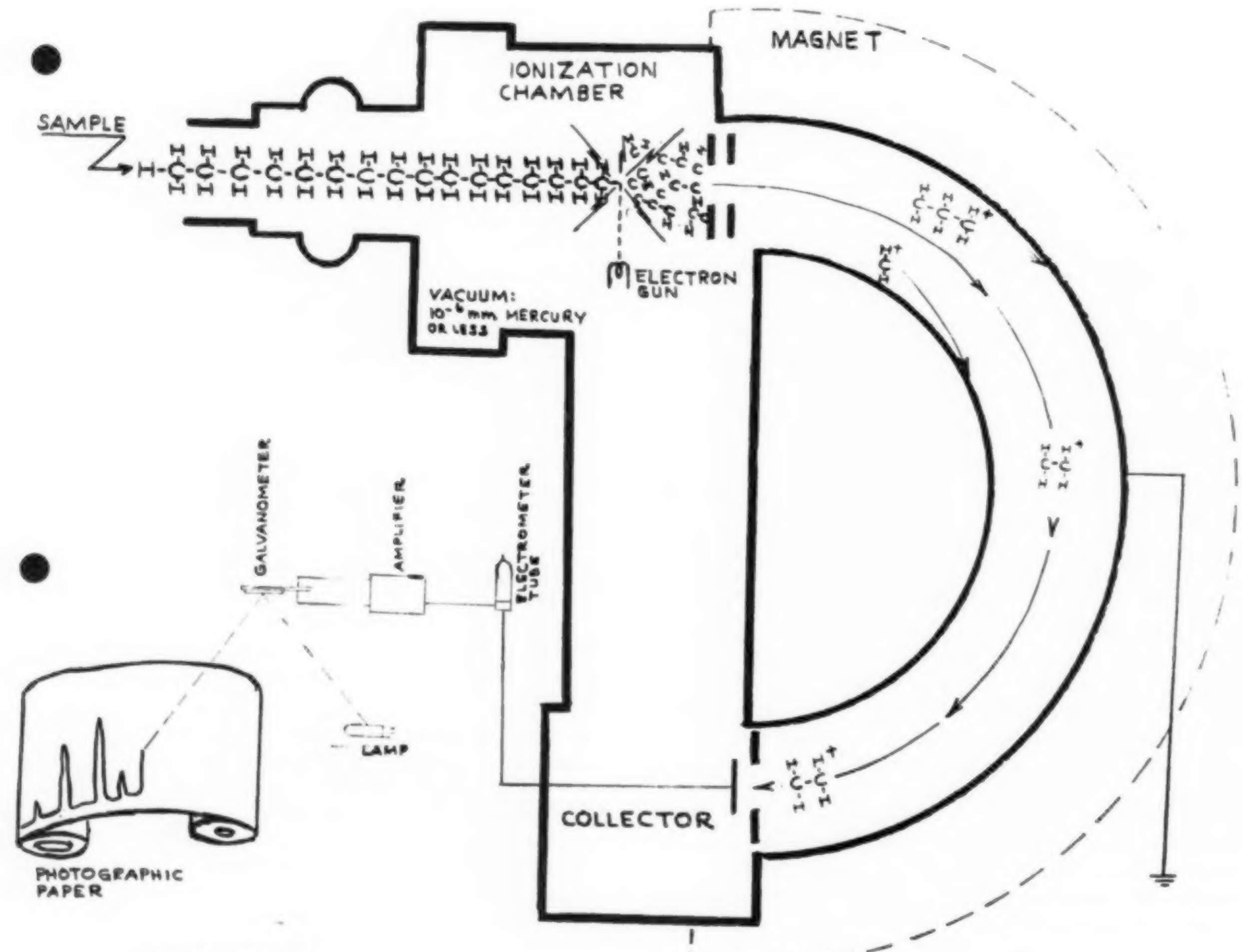

FIGURE 1

they march into the line of fire of a Big Bertha *electron gun* which shatters their ranks into billions of fragments called ions. See Figure 1.

Each ion has a positive charge and a definite weight depending on the number of H's and C's left in the ion.

Next, the ions are subjected to a positive potential called the ion accelerating voltage. The positive charges repel, hurling the ions out of the *ionization chamber* and into a 180-degree horseshoe-shaped tube immersed in a magnetic field. As they enter the tube, the hugh magnet creates a strong magnetic field that pushes the positively charged ions around the circular path of the tube. Whether they come out the other side of the tube or not, depends on three things: The weight of the ion, the strength of the magnetic field, and the ion acceleration voltage.

Look at it this way: The ions in the magnetic field act very much like a ping pong ball and a baseball would act if you threw both of them down the street together while a strong wind was blowing across the street—the ping pong ball would be blown farther sideways than the baseball, because the ping pong ball weighs less.

Similarly, the light ions are pushed around the tube by the magnetic field and out the other end, while heavier ions go in a straighter path, hit the side of the tube and are grounded.

As the strength of the magnetic field is increased, the light ions are pushed harder, curve more and ground out on the side of the tube, while the heavier ions are pushed in the right curve to get them around and out the other end of the tube.

As the ions for each magnet setting come out the end of the curved tube, they are collected on a plate and are turned into an electric signal that is amplified and fed to a bank of five galvanometers; each with a different sensitivity. A mirror mounted on each galvanometer, reflects a tiny beam of light onto a roll of photographic paper; the paper moves as the magnet current is changed.

Thus, a complete photographic spectrum of the amount of each ion-weight is obtained by setting the magnet for a given field strength and collecting the

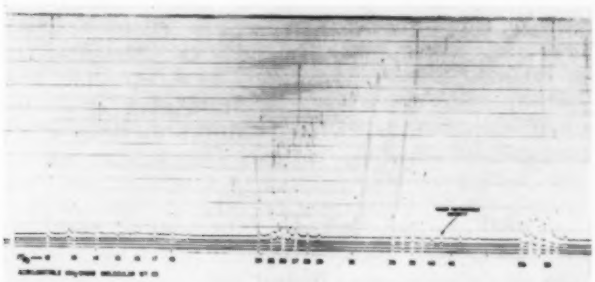

FIG. 2. A section of developed photographic paper called a spectrum. The baselines of five galvanometers, each with a different sensitivity, can be seen along the bottom (dark lines). The peaks are the fingerprints of the sample; in a given sample, they always appear at the same mass to charge ratio (m/e) number shown at the bottom.

FIG. 3. The operator is adjusting a calibration knob on the control panel of the Type 21-103C Consolidated Electrodynamics Mass Spectrometer. The magnet can be seen to the left of the operator, and the inlet system is behind him.

ions of one weight; then changing the magnet setting and collecting the ions of the next weight; and so on until the amount of each ion-weight is recorded.

This ion-weight spectrum of peaks and valleys would be useless for analysis, except that the molecules of the compounds being analyzed *always* form the *same* ions. Therefore, a spectrum of a pure compound becomes a "fingerprint" that can be used to analyze unknown samples.

Sample spectra, as the photographic records of the

(*Continued on Page 88*)

FIG. 4. Julian C. Holmes (right) and Charles Y. Johnson, members of the Naval Research Laboratory, standing in front of the spectrometer electronics of the Aerobee-Hi, are each holding Bennett radio-frequency ion mass spectrometers. Official United States Navy Photograph.

Personal Factors in Withdrawal from Medical School

• By L. W. Earley, M.D., Professor of Psychiatry
UNIVERSITY OF PITTSBURGH SCHOOL OF MEDICINE, PITTSBURGH, PENNSYLVANIA

This paper was read before a meeting of premedical advisors conducted by the faculty of the University of Pittsburgh School of Medicine on May 20, 1960.

High school counselors and college premedical advisors will find this paper worthy of serious study.

The number of students who, having survived all the necessary hurdles of entrance to medical school, then drop out is substantial if one takes into account the cost to the student, to the school, and to the community. In all instances the number of admissions to a given medical school is fixed by its physical facilities. Loss of a student for any reason leaves a vacancy which cannot be filled. All in this audience are aware of the substantial work, the careful individual care, and the safeguards which admissions committees expend in trying to assure stability in a class after selection. If under these conditions breakage occurs we need to look at some of the factors which bring this about.

These remarks will be an impressionistic survey of a six-year period at the University of Pittsburgh. The impressions given have been assessed against knowledge of the three years prior at this school and a four-year period of intimate study at the University of Illinois Medical School and a less intimate knowledge from records at the University of Chicago Medical School over the same four-year period.

A word first about the bias of such a look—I am a physician first, biased in the direction of a clinical view, interested in individual histories. But the nature of my clinical experience has shown from the first that in human behavior there is rarely singleness of motivation, especially in the determination of a single but complicated act, such as withdrawal from a career pattern. One has to look at broad social phenomena, more intimate social phenomena—such as class differences, as well as a multiplicity of much more personal factors. As a psychiatrist the primary biases I bring to looking at the individual reasons for withdrawing from medical school are two major ones and a whole series of related though probably less important ones. However I am aware that "less important" does not mean that in an individual case a "reason" which is rare may not be primarily defining in that case.

My major approach in the individual instances includes first, that motivation is primarily unconscious; second, that conflict is an inevitable element in all human behavior. I am unwilling to accept many original statements at face value—I find it always necessary to try and look beyond the surface and especially to look for evidences of motivations which go in opposite directions. I am well enough aware of the complexities of assessing behavior to know that from the data one has, one can only make educated guesses about motivation.

First let us state on what kinds of material the following statements will be based. When a student wishes to withdraw from this school he is interviewed by the associate dean to see what the nature of the problem leading to this desire is. Hopefully a change in the desire can be brought about—and it is—in a substantial number of cases. This results from a judicious combination of two attitudes in the associate dean. The first of these is that his manner of approach stresses the positive values of continuation in school and the social and individual reasons why the person can hope this will be a reasonable decision. The second approach is stressed much less by him, but is clearly stated. That is that a student who has withdrawn will have nearly insurmountable difficulties if he wishes to enter another school after changing his mind. These two attitudes have seemed to me to meet excellently the internal conflict which the student is presenting and offer him greater strength for choice of that motive or set of motives which will lead him to stay in school.

In any case the associate dean refers a student to me if he wishes to drop out. This is done on a voluntary basis, with the statement that motivations for withdrawal are a matter of scientific investigation. Those students who are willing to cooperate are again seen by me with the avowed intent of discovering further or previously unstated factors leading to the withdrawal. Though it is certainly not the primary purpose of my interview such an investigation has on some occasions brought into clearer focus for the student some of his own motivations so that he has remained in school. Again, it is my general impression that every student in the position of withdrawing from medical school is carrying a heavy load of anxiety whether open or covert. It is always the idea of this interview to offer some help in allaying this anxiety whether the student remains in school or not.

In addition, the student's prior records have been examined. These are for the most part the same records used in selecting the student for school, maximally the application blank, prior college and high school records, pre-medical adviser's records, letters of recommendation and records of interview prior to admission.

The number of withdrawals over the six-year period have been 45 ranging from 5 in 1954-1955 to 13 in

1955-1956. With these sources of information in mind let us look at several general categories of reason as they are stated on the records.

I. Financial. Over the six years, finances are stated to be the reason for withdrawal in a single instance. This man has now completed medical school in another city. All other instances both at Pitt and the other schools show clearly that finances were at most one of several convergent reasons for withdrawal. When one considers these instances and all the other causes of withdrawal and breakage one is much more inclined to regard lack of finances as purely symptomatic rather than determining. One thought is that those who give lack of interest as a cause for withdrawal are in financial difficulty. No good evidence of this can be found. Another is that financial instability is more hidden from interviewers than other factors. But the interviews have taken this possibility into account.

As stated the impressions from these students compare almost absolutely with impressions from the other two medical schools. Just as I long ago came to the conclusion that lack of finances never unitarily kept a student from pursuit of a medical career, so I do not believe it causes him to drop medicine.

Parenthetically, this does not imply that students do not need monetary help. Strictly as a physician, symptomatic treatment of this kind can be alleviating and allow students energies for dealing with other conflict. And as an educator, I do not believe one should put unnecessarily heavy burdens of any kind in the way of one who pursues knowledge.

II. A large number of instances are simply stated as "lack of interest." This is one of the most difficult of the categories to analyze. Presumably, not only the student but his premedical instructors, the whole admissions committee and at least one individual interviewer have examined a man carefully for his motivations for coming to medical school. None of these outsiders is naive. How, then, can such a category appear? One possibility is that the student is a blatant liar. Or more likely it is that characterologically he can be described as narcissistic (egotistic), dedicated unitarily to the pursuit of his own immediate needs, unconsciously histrionic enough to manipulate some very clever people who want to help him. Such a person is not unknown in medical schools. Such a person faced with the manifold difficulties in medical school can use "lack of interest" as an ego-syntonic reason for withdrawal. In actual examination of the records at Pitt I find one instance where unrelievedly this is the case. Curiously, without using the particular language above the medical interviewer recognized all of these qualities and warned the committee. This warning however was phrased in terms of "immaturity" and being a "three-year student." The committee did hold the student off for one year, clearly writing off as a growth phase what was a settled character pattern.

There are other instances where something of the qualities described above apply, but in a less harsh form. The student is less blatantly self seeking, is truly unaware at deep and invasive levels of his self-centeredness. Many of these that fit here or partially fit here have been described by high school advisers, premedical advisers, and by our own interviewers as "real nice boys." Looking at it after the fact it is a little easier to see how everything conspired that these students should run the admissions gamut. Before the fact, it is a more difficult problem adequately to "spot" and even more to deal fairly with students in this category.

Corollary to the latter statement is the fact that a small number of students in every one of fifteen classes I have known approach the characteristics described. These are men who do have adequate reserves in other areas, and do go on to completion of school.

As one pursues the group of "lack of interest" further one finds a related constellation of qualities in a number of these students. The easiest quick description of this is that these are people who have never looked closely at themselves, who have little in the way of the introspective qualities, who give motivational reasons in facile or intellectualized terms. Often one sees them as quite denying of any except the simplest and most circular of motivations. Associated with this one may see bland denial of any attempt to look behind the concrete and uneasiness or irritation when asked to do so.

As a psychiatrist I look on this group as representative of at least two varieties of internal conflicts which can sometimes be recognized. One type of man, frightened of looking at his own internal processes, curious about these, but long scared by what he does see when he looks, meets living with a rigid, stereotyped pattern of behavior. In him minimum rebuffs in the freshman year can lead to a relatively facilely stated "lack of interest" withdrawal. Another type, curious about his own motives constantly looks at himself, sees first one motivation then another opposite one and finally resolves the conflict by saying in effect he is not interested.

Finally in this group there is an occasional man who does have "lack interest" in the sense he does not have adequate push, cathexis of goal, ambition to withstand the inevitable interference with comfort or dependent needs which medical school represents. Such instances have been rare. Consider the crucible of experience through which these students have gone and one sees why it is rare. But as a type form not pure, but approaching, there are indicators of these aspects in a few. As a warning, however, where a man essentially expresses himself directly as being like this, I have generally not found him so. What I describe when it does occur is behaviorally expressed in study habits, social situations, sports, reading, previous work (or lack of) patterns with the man at most being only dimly aware of the meaning of his behavior.

In most of the instances where such a set of circumstances is operative, the students are better than normally endowed relative to their fellows. Usually, this has in their previous academic career given them a

cushion on which to operate. I am aware too, that there are instances where there is operative the factors described and the student has adequate "cushion" to go on to complete medical school. Again no single factor, or set of factors determines early withdrawal.

Parenthetically, I can find no instance where a young woman withdrew for lack of interest—and I have one class with 18 women in it.

III. Our records show a number of students who withdraw failing. These are students who in our judgment would almost certainly be lost by administrative action if they did not choose to withdraw themselves. I include this group because in actuality, the choice is literally the student's, because the problems presented are similar and contiguous to the other withdrawals and because they constitute a bridge to understanding the even more blatant academic failures.

It would be nice for us if this group were uniformly or even largely made up of students with poor academic records and/or obviously poorer endowment than those who stay in school. One can only say at the most that there may be a tendency as a group for these things to be so. But group tendencies do not make individual predictions and as so often already noted do not adequately explain. For every student in the present group with a low academic record and/or low basic endowment, we have others with the same academic records and intelligence who have gone on to complete medical studies and gone into successful practice. We have students with high biological and social potential, and high past performance who have failed.

Let me give a series of thumb nail sketches as illustrations.

1) A 21 year old female 2/341 in high school, 3.3 of 4 average at a sound university, engaged in a number of extra curricular activities, A.C.E. intelligence scores well in the upper 20% of her college class, essentially failed all of the anatomy courses in the first semester and was advised to withdraw from school. She did so after six weeks of uneasy trial of the second semester work.

One can say clearly there must have been some prior indicators of the end result. After the fact there were—MCAT scores were 37—49—36—39 and there was a rather marked fall off in the senior year university work. But this same class had other students who had similar records. Of the reasons suggested the second one seems to me to be a more relevant consideration. In addition, looking backward one finds the student stating primary desire for medicine as stemming with what was essentialy a fear laden observation of a sudden and dramatically expressed illness. However, again, such motivations are present in other students.

2) A 22 year old male 7/374 in high school, Otis of 138, MCAT 62—68—68—69, graduated Magna Cum Laude from an excellent university with nothing in his record except high recommendations. How does such a man manage to abyssmally fail all of anatomy? In this instance I again have a partial explanation. He fell in love and couldn't decide whether to get married or not. But again this can only be partially explanatory. Falling in love is only the end result of a whole series of prior events.

3) As a counter balance to the above—a 25 year old man whose father was a physician obviously pushing him into medicine. He had three prior rejections from medical school, was 5/5 in high school—B average compiled at three different colleges—MCAT 41—39—41—35. He withdrew in the sophomore year because of illness (partially emotional). He then returned and completed school with an unspectacular record, but he did complete.

IV. These examples lead to the fourth category of those who drop out. This is a category which cuts across all the other areas. Actually, there is nothing simple or unitary involved about those who leave medical school because of illness. Physical illness *per se* is relatively rare. Most of the students are of an age which has little physical illness and that usually of short duration. Those few on whom our records show withdrawal from medical school because of physical illness alone all return to school and all have finished except one who possibly might be classified with the group. More likely, his illness contained much more of an emotional nature than physical.

The bulk of illness which causes students to withdraw from medical school is clearly of an emotional nature. A short description of the conflict factors involved in medical school will be given in order to present the environmental and person milieus in which emotional illness develops.

Some of the emotional problems which are inherent in being a medical student are inherent in his age and academic position. It is interesting that the general attitude in medicine seems to place the medical student somewhere between undergraduate and graduate status—and, alternately, to put him first in one then the other. At times he is expected to behave like a late or just post-teenager, at other times expected to behave like an adult. Perhaps there is some reality in this—but too often this expresses the needs of the faculty and little more.

Then, let us look briefly at the needs of being a student as such. Students generally have a fear of exploitation. Often a superficial statement of this is "leave me alone." The exploitative fear shows itself in a fear that their needs will be taken advantage of or that they will be sneered at. Students are ashamed to ask for help. This shame, inherent in the maturation process, can be further stimulated by either the instructors or by pressure of fellow students. All forms and degrees of this can attach to seeking advice. Sometimes it is expressed more openly as embarrassment, perhaps accompanied by the visceral evidences of that affect. At times the individual hides this shame under the cloak of an over-reactive competitiveness, announcing by word and behavior to all around him that he "will do it on his own." At the same time, the seeking of advice stirs in the other students all the competitive

urges which have operated in bringing them this far on the educative ladder. This competitiveness results in all degrees and forms of reaction against fellow students who attempt to win the competitive battle by asking help from teachers.

Since instructors are also human, they tend to have the same feelings about those who ask help as the students do. Some instructors will tend to ward off attempts at help as expressive of the infantile. Others will look on the need for help as a demand on their own precious time.

Now what of the special academic area of the medical student? Prior to medical school, he is expected to have mastered fundamental concepts which have to do with living matter. At the present time he is perhaps expected also to be a chemist of sorts. As a student he is like other students, but different too. He has different problems, a different intellectual area to master, and an altogether different affective area. His special problems can be listed as masses, if not depth of material to be mastered, involvement of relatively large amounts of time simply being in class, the shock of having generally a higher competitive level to meet, learning to deal with death in the form of cadavers, and developing defenses against the powerful imagery of mutilation. At the same time he is in the position of having to postpone his dreams of treating patients for an additional period.

A further word about this latter situation is in order. Basic to the desire to be a physician is the healing or helping wish. This desire cuts deeply into the instinctual and developmental aspects of the individuals involved. The desire to help or cure is inevitably associated with anxieties about and identification with those who are hurt and in need of care. The process of becoming an adequate physician requires that these anxieties about injury and about blood be mastered and externalized. All students who are truly worthy of consideration have some of this basic conflict present. Given any class there will be a wide spectrum represented as to the degree to which this conflict is already mastered and in the degree to which the anatomical laboratory will relight and reinforce these feelings. It remains true that the medical student's "first patient" is the cadaver. Much danger lies in this fact, but much in the way of future essential dignity in dealing with death and death dealing processes is also inherent in this fact.

With this general description in mind, the following examples are given. Not a single one is a clear or separate example of any single factor. I could find no instance either in the material from Pittsburgh or the other two schools where single factors operated. The examples were picked more for the variations in administrative outcome than for any particular emotional constellation demonstration.

The first example administratively falls in the group who withdrew because of "lack of interest." He was a 23 year old man, not married, with a premed record of 2.4/3. Originally he planned clinical psychology as a career. Though his A.C.E. scores were slightly below average for the group admitted, his professors described his intelligence as high level and from other evidence there is reason to believe this was accurate. He was accurately characterized as with strong ambition and drive, and was a member of several leadership groups. When he was interviewed on leaving, it became clear that "lack of interest" covered a strong unconscious fear of work with the cadaver. This conflict was clearly presented in dreams, as well as being evident in several other areas the interview covered. This example is presented not because this was the focal point of his difficulty. It was, but other elements were involved. The energy utilized by this man in binding the anxiety which was stimulated by his mutilation phantasies interfered with his strong competitive drives and immobilized his ambitions. His productive work was being seriously interfered with. The conscious reason for withdrawal was "lack of interest," but this obviously screened a multiplicity of other factors.

Actually in several others who have given "lack of interest" as a cause of withdrawal, this particular conflict has operated, but not so clearly focused as here. In addition, there is not a year which goes by when we do not see the conflict in at least one or two students in whom anxiety is interfering with their scholastic productivity. Generally, we are able to help these men—not necessarily totally resolve their anxiety, but at least help them to the point they can successfully complete their work.

2) This man was a sophomore with a reasonable freshman record. He came to medical school with a background of success in athletics, 1/5 in high school, a university average of B+, an intelligence score in the lower range of those accepted, but a statement from his premedical advisers that his work was "far better than his scholastic aptitude showed." Midway in the sophomore year, he began to do badly, casually complained of headaches and an unfortunate diagnosis of post-traumatic head injury was made. He was clearly depressed and anxious and clearly unable to do his work. Professors, especially in one subject advised there was no chance of his passing. In this instance, we had to insist on his withdrawal from school, with a clear promise to return when he was able to do the work. His own strong pride would not permit him to make the decision himself. After withdrawal he received some psychiatric help, but particularly his own strong directions toward health were given a chance to operate without his being subjected to progressive failure. He returned to school the next year, has now graduated and will unquestionably do well.

3) This was a 21 year old freshman with a good high school and excellent university record. He is a powerfully ambitious and competitive man and lack of warmth and originality were noted when he was interviewed. There was no question of his not being admitted, however. His overall record, his endowment, his career line were all excellent. However, midway in his freshman year mounting anxiety, competitiveness with a stepfather, difficulties in living at home for the first time

(Continued on Page 94)

A Safety Program for University Chemical Laboratories

• By G. N. Quam, Ph.D. (Iowa State University), and
• Marshall Fishman, B.S. (Temple University)
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This paper was presented at the 1960 meeting of the Pennsylvania Round Table of Science at Duquesne University, March 26, 1960.

Mr. Fishman is a graduate student in Villanova University.

Any teacher of Chemistry is well aware of the dangers in laboratory practice. In this brief discussion we do not pretend to present anything new but we hope we have succeeded in bringing together some very useful information and applications. Our Chemistry laboratory manuals have words of caution and first aid suggestions which tend to aid the alert teacher.

Like all Chemistry teachers we of Villanova have been conscious of the need of a safety program. We have installed more effective blowers for our hoods; purchased a number of 10-lb CO_2 extinguishers and deluge showers; and instituted a program of inspection. Not until this year have we entered upon an orderly study of safety. This was made possible by supporting my coauthor, a graduate student, with DuPont funds for the year 1959-60. Mr. Fishman has developed a bibliography of over 150 items.

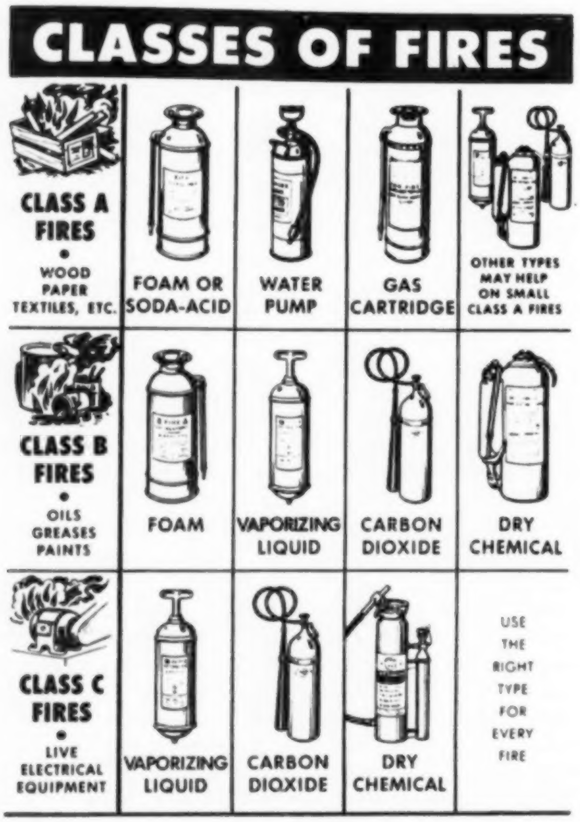

Exhibit 10–3. Safety poster, National Safety Council, Chicago, Illinois.

We must not alow ourselves to be lulled into indifference because our accident record is fairly good. Not every violation of a safety rule necessarily ends in an accident—those that do may be tragic.

Industries have made great progress and some safety engineers have become quite critical of schools in general. One safety engineer of a well known pharmaceutical company wrote:

> "We in Industry have a problem with new employees fresh from the campus. We attempt to have the best and safest facilities but often this expenditure is nullified by the unsafe habits and unsafe practices of these men. The only place they have acquired these practices is on the campus."

This is a rather severe indictment.

The big question is: how can we best develop in our students, our product, a high degree of "safety mindedness" as opposed to an attitude that may be summed up in the expression: "*nothing has happened yet*."

The Chemistry instructor must always be alert, capable of anticipating possible dangers in his class.

Broadly speaking, our program should provide for:

(a) adequate well planned laboratories and facilities;
(b) getting and using all possible available safety equipment;
(c) training of teachers and students in good housekeeping; and
(d) an educational program assuring a high degree of safety mindedness.

I Laboratory Design

We will consider first laboratory design.

The multiple story building should have two or more adequate stairways. Escape by stairways should require walking a relatively short distance, 70 to 100 feet as a maximum. Laboratories having the heaviest traffic (e. g. general, analytical and organic) should be located on the lower floors. Each laboratory occupied by more than five to ten students should have two or more exits. Such doors should swing outward into hallways. *Corner rooms or secondary rooms* having but one exit to the hallway should have an escape doorway near the outside wall into an adjacent laboratory. This escape may be a small and free swinging door just

large enough to crawl through. Its lower edge may be above desk tops to avoid loss of wall space for furniture.

If a laboratory is rated "*high hazard*" doors must be not only outswinging but equipped with "*panic hardware*."

Perhaps the greatest hazard in university laboratories is *overcrowding*. The great increase in population is one cause or excuse for this bad situation. This is bad not only because of the safety risks involved in our laboratories but also bad because of less effective teaching—this is particularly true of laboratory teaching at the lower level.

Ceiling lights should be ample to provide the equivalent of daylight.

Steam lines should be covered with insulating material. Exposed hot pipes or valves should be marked clearly with the word, "HOT."

Shut-off valves for gas, steam and water and master switches should be placed in strategic and accessible places. Instructors must know the locations and how to operate these devices.

Telephones are essential for calling for help in case of emergencies. Phone numbers of fire department, police, campus infirmary, campus or nearby hospital should be clearly printed in student handbooks, or laboratory bulletin boards, first aid charts, first aid cabinets, and in each phone book. Twenty-four hour switchboard service is most desirable; secondly, the accessible department phone can be plugged in for outside calls for late hours or weekends; thirdly, a supply of coins of correct denomination for a phone booth can be provided in an accessible place. It has been suggested that a glass slide be used as a cover for a coin box. A *broken slide indicates* the phone has been used, a report made out. A new glass slide can be checked out from the storeroom.

During off hours no less than two persons should be allowed to work in a given area.

The *lay-out of permanent furniture* should allow easy escape, that is to say, *furniture* should not be arranged in such directions that it becomes obstructions in case of panic. *Width of aisles* in laboratories should be adequate—5 feet should surely be the minimum.

Safety shields (*bench type or suspended*) afford good protection against spray or flying glass or other solids.

Adequate ventilation is essential to avoid build-up of flammable or toxic gases. *Hoods* should have face velocity up to 150 feet per minute for highly toxic and flammable gases. *Lights* in hoods should be vapor proof and explosion proof.

Many serious injuries to the body and eyes can be avoided by effective deluge type overhead *showers* and *eye-wash fountains*.

The *location* of *high pressure* equipment has received much attention. For example, a high pressure hydro-

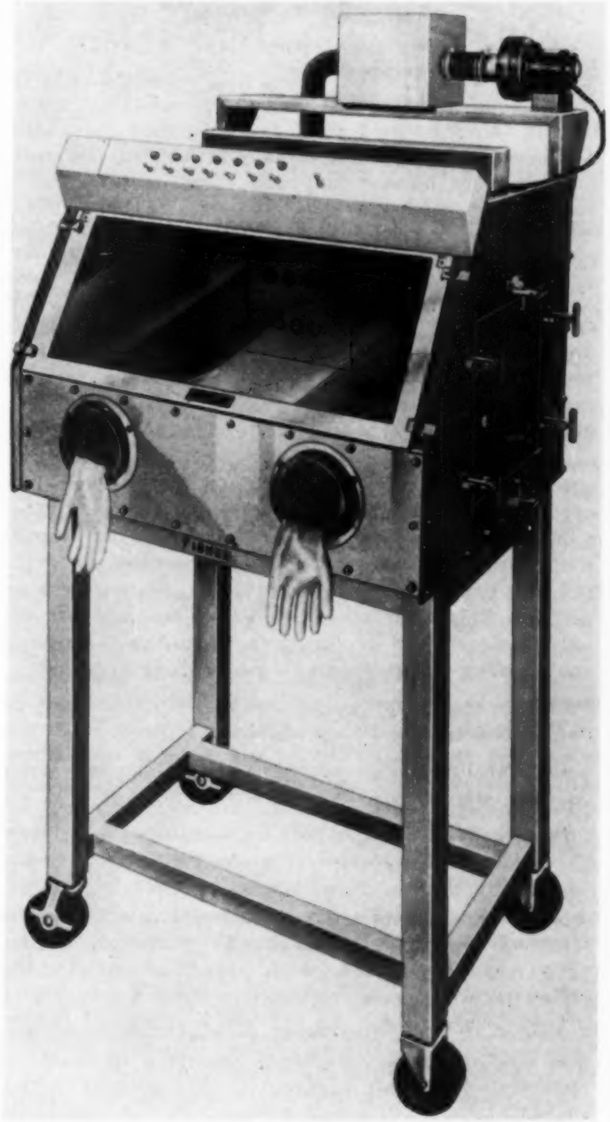

Figure 2

genation shaker should be within a heavy steel cage against an outside wall, preferably a *blow-out wall*. The hydrogen cylinders can be housed outside the building and the gas led in by way of a stainless steel pipeline.

Fire alarms, *fire doors*, and *automatic fire extinguishers* are not only desirable but imperative.

Contrary to our all-too-common practice *storerooms* should be spacious—large enough to provide space for all chemicals and apparatus not currently used. Unwanted supplies in laboratories can quickly become annoying obstructions and real hazards. Location and form of construction of *supplementary storage space* depend on the materials to be stored, e. g. compressed gases, corrosive chemicals, flammable chemicals and high vapor pressure chemicals. The latter should be in a cool room on the ground floor open only to the outdoors.

II Safety Equipment

Secondly, safety equipment may be divided into laboratory and personnel.

Fire blanket racks and cases should make a fireproof blanket easily released and wrapped around the victim. An *encased blanket* is more easily kept clean and ready for use. The blanket may also serve as cover for a shock victim—e. g. one who has inhaled Cl_2 or suffered shock by an explosion. The blanket may also serve to smother fires confined to small open containers.

The selection of *types* of fire extinguishers depends on the kinds of fires anticipated. The classification of fires into Classes A, B, C, is used in selection of equipment. ILLUSTRATION. For most chemical laboratory fires the CO_2 extinguisher is effective, clean, and easily handled. Two and five pound CO_2 extinguishers are quite satisfactory for office-laboratory combinations but for class laboratories several ten pound CO_2 extinguishers are good precaution. If Class C fires are anticipated a non-conducting extinguisher is required. Conventional fire extinguishers are not to be used for extinguishing burning active metals such as sodium or magnesium. These may be smothered by dry soda-ash, dry sodium chloride or dry graphite. Graphite is the only one of these agents bearing Underwriters approval.

Vaccum desiccator guards are available to head off flying glass in case of an implosion.

Pipeting of toxic or corrosive liquids can be carried on with several types of commercial *pipet fillers*.

Bottle carriers made of hard rubber or modern plastics are available for carrying bottles of corrosive or toxic liquids.

Many experiments require *controlled atmospheres* or *shielding*, or both. ILLUSTRATION 2. *Boxes* can be made or purchased for such work (some of metal while others of transparent plastics).

Personnel: The distinction between laboratory and personnel safety devices tends to merge in many instances as is already apparent in this discussion. For convenience we will consider immediate body protection or temporary devices made by hand.

An example of the latter would be the application of *electrician's tape* to the *outside* of a *Dewar flask* to prevent flying glass in case of implosion. Lab. coats may protect clothing; rubber or asbestos gloves may serve as protection of hands against corrosive liquids or against heat. The face may be protected by a *large face shield* while comfortably fitted *eye shields* protect the eyes. The low cost of plain plastic glasses now makes it easy to include a pair of them in the student's non-returnable kit. *Glass blowing glasses* are essential for work with oxygen flames. *Respirators* of various types are made to protect the nasal passages and lungs against dust, corrosive and toxic gases.

III Housekeeping

Good housekeeping as applied to university laboratories includes many items but we can sum it up briefly under "*effective maintenance* on the part of *building force, instructional staff* and *students*."

1. The presence of obvious hazards can be reduced to a minimum by: (a) *returning* all *unnecessary equipment to* the *storeroom*; (b) keeping stools, *dollys, trucks*, etc. in special assigned places and not in aisles or hallways (rolling conveyors are among the most used items of laboratory equipment); (c) keeping *table tops* and *hoods clean* and cleared for work; (d) avoiding placement of tall equipment near edges of tables or shelves.

2. *Ladders, trucks* and *shelves* should be sturdy and in good repair. Many serious injuries have resulted from weak or broken ladders. Weak shelves have resulted in loss of chemicals, injury to personnel, and even fire.

3. *Table shields* must be kept in assigned places when not in use and kept in good repair and clean.

4. Equipment with moving parts such as blowers, centrifuges, trucks, shakers, etc. should be lubricated with the recommended lubricant according to a schedule to assure efficient, quiet operation.

5. Fire extinguishers, sand buckets, *fire blankets* after use should be checked and made ready for service. *Deluge type* showers should be checked on a definite schedule for ease of operation and effectiveness of valves and water pressure.

6. "No-Smoking" signs should be strategically located and the intent enforced. Areas permitting smoking should be clearly identified.

7. First-aid cabinets should be strategically located and always checked for supplies. The storeroom is a logical place for reserve supplies, as well as a model first-aid cabinet. A microscope slide can be used to make the door secure. When a slide is broken here the same procedure is followed as for a broken coin box slide for the telephone. The person administering first aid should make out the report and secure a new glass slide from the storeroom.

8. *Cylinders* of compressed gases can become *dangerous if* valves are *broken* by a fall. For moving cylinders a two wheel cylinder truck is most effective for the inexperienced person. Cylinders should always be secured when stored, or when in use, by chains, ropes, or straps.

9. Fractured glass or stoneware can become serious hazards. Injuries and damages can far exceed the cost of replacement.

10. *Leaks* of water, steam or gas lines should be reported at once for repair. Sinks, troughs, and traps must be kept in repair and clean to avoid damage. Rubber hose connections should be checked for aging at frequent intervals to avoid uncontrolled flooding.

11. *Pilot lights* visible to the exits can do much to avoid unnecessary loss of power and heating elements. *Valve handles painted* in brilliant colors can also aid in "checking out" a laboratory.

12. Safeguarding personnel requires immediate removal of *spilled toxic or corrosive materials* from shelves, tables and floor. Whenever *hazardous chemicals such as* CS_2 or powdered magnesium are used the

(*Continued on Page 82*)

The Superior High School Student

• By Kurt C. Schreiber, Ph.D. (Columbia University)
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Are we overlooking the strong points in our American high schools?

Do advanced placement programs, enriched programs, and college level courses such as calculus really provide for the needs of the superior high school student?

The author received his secondary education partly in Europe and partly in the United States. ●

●

Since the early fifties, educators throughout the United States have been examining our secondary school educational program. With few exceptions, they arrived at the conclusion that, while we had been greatly concerned with the education of the mentally retarded child, we had neglected the child with above average capabilities. As a result of these investigations and of the pressures that were brought upon our school systems due to our early failures in space technology, many high schools developed special programs for the gifted. These programs can be divided into two groups; both of them, however, depend on selectivity at some stage.

In one type of program, the above average student is selected for additional *advanced* work in a particular subject, after he has completed the normal high school course in this subject. In other high schools the student is selected early in his high school career (usually during the sophomore year) to register for special courses *instead* of the regular high school courses in some subjects. In both programs, the *special* courses are often equivalent in caliber to freshman college courses.

There are several problems that should be mentioned in connection with the first approach. One of the criticisms of our high school program of the past has been that the gifted student is not challenged sufficiently, becomes bored, and loses his desire to continue his education. The philosophy under the first plan is that the student will be properly stimulated by the additional course, but, unfortunately, he does not take this course, until he has already been subjected to a previous year of waste and boredom.

There is a second factor to be mentioned which makes this approach even worse. Up to the present, our high school curriculum has been fairly rigid with respect to the number of courses in which a student may register and the number of class hours per year for each subject. Thus, a student usually registers for five subjects, each of which he will have for one period during every day of the week. A student who is interested in science and engineering and expects to continue his education in college should have at least the following before entering college: English (four years), mathematics (four years), science (four years, including one year each of physics, chemistry, and biology), foreign language (three years of one or two years each of two), history (two years), economics and government (one year each or one year combined). This would nearly fill completely the program that a student would take in his High School career. If he takes advanced courses in a number of these subjects, he will then have to drop some of the subjects in the nonscience area. Such a procedure is to be highly deplored.

Our colleges have been criticized for overspecialization and for denying the student the opportunity to obtain a broader outlook on life during his educational experience in college. The recent development of plan one in High School has brought before us the possibility of specialization in High School with college serving more and more as the sole place for educational broadening. This is a highly undesirable and inverted situation.

There is a second reason why the reduction of nonscience courses for our above-average students is to be deplored. The constant stream of articles in our newspapers and magazines in recent years about scientists and engineers have given our youngsters a good idea about the work of the scientist and the engineer. Many decide that they should go into these fields because of this publicity and not because they are best suited for them. If we are to retain our world leadership, it is absolutely essential that some of our outstanding students elect careers in the social sciences and the humanities. But, with the small amount of publicity about these areas, the student will not usually select these, unless he is exposed to these subjects during his High School training.

The second approach makes it possible for the gifted student to take a number of these special courses. Since these courses will be replacing the regular high school courses, the student will still be able to take the nonscientific subjects. Also, the student taking a number of these special courses will have to work hard to keep up with his class and thus will develop good study habits, which gifted students do not develop if they are allowed to breeze through high school with high grades and little work. If these courses are really of freshman college caliber, then the student has the opportunity to take the Advanced Placement Test administered by the Educational Testing Bureau in the particular subjects and may receive advanced placement in college. If, in the years to come, advanced placement of above-average students becomes commonplace, it may help to shorten our educational process or, at least, to prevent its becoming longer as our knowledge increases at a tremendous rate.

From the standpoint of teacher employment, the School Administration must have a qualified teacher either for the presentation of a high-caliber second year course or for the offering of a special section of the first year course for the gifted students. From a pedagogic standpoint, however, the second path is much more desirable.

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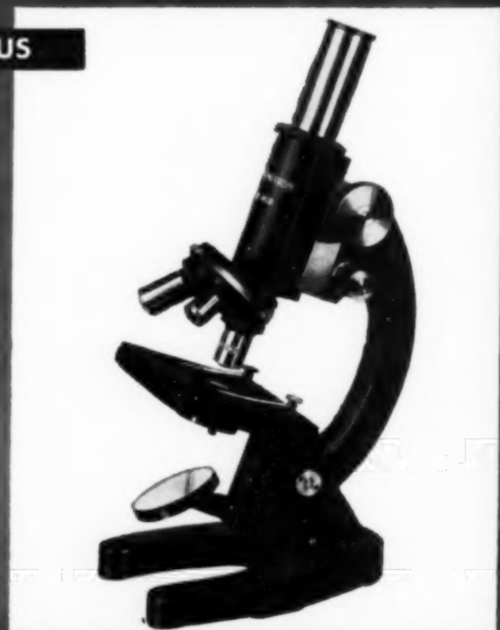
Despite its low cost, UNITRON Model MUS offers features lacking even in much more costly models usually offered for student use. For example, both fine and coarse focusing are provided — not merely a single focusing control; an iris diaphragm to regulate aperture for highest resolution — not merely a disk diaphragm; and a condenser system for optimum illumination.

The optical performance of Model MUS at each of its magnifications is equivalent to that of expensive research models. All mechanical parts are machined to close tolerances and the stand is beautifully finished in black and chrome. Model MUS comes complete with triple revolving nosepiece and three objectives: 5X, 10X, 40X; choice of two eyepieces from: 5X, 10X, 15X; coarse focusing (accessory safety stop available); condenser with iris diaphragm; inclinable stand; planoconcave mirror; wooden cabinet and dustcover. Mechanical stage available at extra cost.



In quantities of 25 or more . . . **$66.66** **only $74**

Laboratory Safety

(Continued from Page 78)

closed containers should be moved away to a safe distance before starting the experiment or demonstration.

IV Educational Program

In order to promote an educational program a member of the Staff may be appointed as the Staff Safety Inspector. He should receive credit on his department workload for the time required for the duties of the office.

Early in the *first semester* at a regular Staff meeting new members should be made familiar with the safety program. A mimeographed outline should be in the hands of all members, as well as an *up-to-date* bibliography of helpful books, pamphlets, periodicals articles, films, charts, posters. The department library should have a number of pertinent books on Safety.

Teachers of a specific laboratory course should meet regularly to be briefed on the possible hazards and safety precautions for the succeeding week or two. Students can be impressed by carefully planned demonstration and "safety" questions in written quizzes and examinations.

At definite calendar dates the inspector should inspect items on his "check-list" such as fire extinguishers, fire blankets and showers, first aid cabinets, shields, hoods, warning signs, posters, etc.

A program of inspection of laboratories in session afford check of safety practices involving the use of goggles, shields, hoods and general housekeeping. Failures to comply with the minimum safety requirements should start remedial action.

A planned check-list is a necessity for the inspector in order that he may not omit any part of the program. Such a list should be of limited edition in order to allow frequent revision. Copies in the hands of each Staff member may serve to alert all to the details.

Selected Reading List

Books and Pamphlets

BOOKS

1. Blake, Roland P., "Industrial Safety," Englewood Cliffs, N. J., Prentice Hall 1958.
2. DeReamer, R., "Modern Safety Practices," John Wiley and Sons, Inc., New York, N. Y., 1958.
3. MacFarlane, D., "Safety in Industry," Philosophical Library, Inc., New York, N. Y. 1955.
4. Pieters, Dr. H., and Creyghton, Dr. J., "Safety in the Chemical Laboratory," Academic Press, Inc., New York, N. Y. 1957.
5. Sax, N. Irving, "Handbook of Dangerous Materials," Reinhold Publishing Corp., New York, N. Y. 1951.

PAMPHLETS

6. "Manual of Laboratory Safety," Fisher Scientific Co., King of Prussia, Pa. 1948.
7. "Safety Manual," Massachusetts Institute of Technology, Cambridge, Mass. 1958.
8. "Safety Practices and Procedures in the Freshman Laboratory," Alpha Chi Sigma Fraternity, University of Wisconsin.

PERIODICALS

9. Burlawn, Edwin C., "Safety in the Chemical Laboratory," *J. Chem. Ed.* 11, 73-6 (1934).
10. Davidson, H. F., "Safety First in Storing Chemicals," *J. Chem. Ed. 2*, 782 (1925).
11. Fawcett, H. H., "Laboratory Safety," *Chem. Eng. News 29* 1302-5 (1951).
12. Fawcett, Howard, "Safety Checks for Chemical Laboratories," *J. Chem. Ed. 24* 296 (1947).
13. Fawcett, H. H., "Supplementing the Chemical Curriculum with Safety Education," *J. Chem. Ed. 26* 108 (1949).
14. Nicholson, Douglas G., "Safety Practices and the Chemistry Stockroom," *J. Chem. Ed. 30* 1889 (1953).
15. Purdue, J. O. and Halley, C. J., "A Laboratory Safety Program," *J. Chem. Ed.* 29 553 (1952).
16. Scheflan, Leopold, "Extinguishing Fires with Chemicals," *J. Chem. Ed. 9* 1503-22 (1932).
17. Sittig, Marshall, "Safe Handling of Alkali Metals," *Ind. Eng. Chem. 48* 227-9 (1956).

★ ★ ★ ★ ★

World's Most Intense Precision Source of Electron Radiation

A huge atomic research machine which will hurl an intense beam of tiny sub-atomic particles at speeds close to the velocity of light with precision and power never before attained will soon be added to the Free World's growing arsenal of scientific development tools. Cost of the accelerator will be more than $1.7 million.

As the world's most intense source of accurately-controlled electron beam radiation, it will provide the U. S. National Bureau of Standards with greatly advanced research and engineering capabilities not available anywhere else. High Voltage Engineering Corporation has been designated to build the new "atom smasher" to meet unusual performance requirements

specified by NBS scientists, the company announced here today.

The new linear electron accelerator—or Linac—will be 100,000 times more powerful than existing NBS high energy equipment. Measuring 100 feet in length, it will produce electron beams with peak energies up to 150 million electron volts and power outputs of 40 kilowatts or more.

New Research Horizons Forecast

The NBS Linac will serve as an experimental tool in research programs involving low temperature in chemistry, metallurgical studies, solid state physics, chemical analysis for minute amounts of trace elements, determination of strength, temperature resistance and other physical properties of irradiated materials, nuclear alignment studies and a host of other important scientific and engineering investigations.

Availability of the intense high energy electron beam, and of other intense radiation such as x-rays, positrons and neutrons, opens up whole new research areas, scientists of the NBS High Energy Radiation Section have said. Increased flexibility and precision made possible by the new Linac are expected to "revolutionize" the continuing research programs in nuclear physics carried out by the Bureau.

"With the increase in electron intensity . . . experiments that previously were impracticable, or which required months of effort and exposure time, can be

accomplished with the Linac in a matter of hours," NBS scientists have stated. "On a national scale, still other fields, such as reactor design, will undoubtedly feel the influence of research with the new accelerator."

It will be able to produce a number of useful effects in materials both for processing and for studies of radiation damage, scientists state. Some of these, such as sterilization of pharmaceuticals and foods, polymerization or hardening of plastics and vulcanization of rubber are of extreme interest to industry. A smaller High Voltage Linac has been in use for more than three years in production sterilization surgical sutures made by Ethicon, Inc., a division of Johnson & Johnson.

The Linac will be installed in late 1962 as part of the new laboratories of the NBS to be constructed on a 550-acre site at Gaithersburg, Md., 20 miles northwest of Washington, D. C. It will be placed below ground level to make use of the earth's shielding protection against the powerful nuclear radiations generated. Individual radiation laboratories will be shielded from each other by concrete walls up to 12 feet thick.

★ ★ ★ ★ ★

Airborne Television Instruction

Eighteen areas in six midwestern states—each with a major college or university as its hub—have been designated as a communications network for the new Midwest Program on Airborne Television Instruction.

MPATI, as it is called, plans to beam instructional telecasts from an aircraft to schools in the six states starting in February, 1961. The $7 million project is supported by the Ford Foundation and contributions of private industry.

In a 32-page brochure just released, MPATI indicated it will administer the program through 18 Area Committees blanketing the multi-state telecast region. Staffed by an Area Coordinator, the Area Committees will consist of school and university administrators, educational TV representatives and lay leaders in civic, professional and other groups in the area.

Each committee will provide liaison between MPATI and surrounding schools and colleges interested in participating in the airborne program.

The Area Committees will be based at midwestern colleges and universities that traditionally have served their respective geographic areas as resources to the schools, teachers and administrators of educational systems in the area.

The 18 colleges and universities that have agreed to work with MPATI as "resource institutions" in this capacity are:

Illinois: Northern Illinois University, Northwestern University, and University of Illinois.

Indiana: Ball State Teachers College, Butler University, Indiana State Teachers College, and Indiana University, Notre Dame University, and Purdue University.

Kentucky: University of Kentucky and University of Louisville.

Michigan: Michigan State University, Wayne State University, and Western Michigan University.

Ohio: Bowling Green State University, Miami University, and Ohio State University.

Wisconsin: University of Wisconsin at Milwaukee.

Two members of each Area Committee also will serve on a Regional Advisory Council to help coordinate the entire six-state program.

Workshops for classroom teachers and school administrators interested in the program have been scheduled during the summer of 1960 at each of the 18 Resource Institutions plus De Paul University in Chicago.

The program's schedule of operations calls for "demonstration" telecasts from the aircraft to start in February, 1961, and continue until June of that year. A full academic year of televised instruction will commence the following September and continue until June, 1962.

The brochure lists a tentative schedule of the courses that will be beamed to the schools within the 150 to 200-mile radius of the airborne transmitters. Ranging from elementary level through college, they include such topics as foreign languages, science, arithmetic, music, social studies, art, the humanities and international relations.

The courses will be prepared at Purdue University in a summer-long workshop for selected TV teachers and related specialists. They will then be recorded on video tape at designated educational television stations.

The brochure contains a section of special information for the schools, advising them on how they can participate in the program, what kinds of receiving equipment they will need and how much it will cost.

The expense of the school's antenna installation increases with the distance of the school from the airborne transmitters.

A map and charts in the brochure are designed to help schools estimate their expense. For example, using a "system installation," it will cost an estimated $500 per room to equip five classrooms of a school within 50 to 100 miles of the airborne transmitters.

In a brief foreword, Dr. John E. Ivey, Jr., president, refers to the project as "an exciting new adventure in education." He points out that "Rigorous evaluation of the educational, economic and management prospects (of the program) will be incorporated into local, state and regional discussion and action."

Dr. Samuel M. Brownell, Detroit (Mich.) superintendent of schools and former U. S. Commissioner of Education, is chairman of the program's governing council.

A "Roster of Participants in Planning and Development" in the brochure lists some 240 persons including—as a special advisory committee—the state superintendents of public instruction in each of the six states.

A total of 40,000 copies of the brochure have been printed and are being distributed to educational personnel and news media throughout the six-state region and nationally.

AO Reports on Teaching with the Microscope

From Oblique Prisms to Rhombic-based Octahedrons...or Cubism on the Stage Scope

Perhaps more than any single other form, the crystal never ceases to awe and impress. The formation of its distinctive geometric shape, which differs a thousand times over is a fascinating process to watch. Possibly this interesting experiment sent us by Mr. Breslau and Mr. Payenson will help you create sufficient student interest in the Microscopic world of Chemical Crystallography to encourage them to further study.

Of course, the criterion that determines what the student sees is the quality of the microscope's optical system. The AO Series 73 Student Microscopes have an excellent optical system coupled with a low price tag that makes it a very attractive buy for many schools. The single, easy-to-use focusing adjustment makes it ideal for classes where acquisition of subject matter is the primary concern. Rugged construction invites hard classroom usage...they are built to service the most active class for years.

EXPERIMENT

By: Abraham Breslau and Irving Payenson
Bushwick High School
Brooklyn, New York

"The recent 1957 Chemistry syllabus issued by the Bureau of Secondary Curriculum Development of the New York State Education Department includes a unit on 'Solutions and Near Solutions'. Topic III of this unit is on crystals, and includes such understandings as the geometric shape of crystals and the formation of crystals from solutions. A common procedure to illustrate these understandings is to demonstrate crystallization by cooling a hot saturated solution of a salt such as potassium nitrate in a test tube so that precipitation results. Crystal form may be shown by using models or a few specially grown crystal samples. The demonstrations have their limitations in their impression on the student. We believe that the following experiment overcomes some of these limitations".

OBSERVING THE FORMATION OF CRYSTALS FROM SOLUTION

MATERIALS AND PREPARATION

Copper sulphate, alum, sulphur, sodium chloride, carbon disulphide, small erlenmeyer flasks, stirring rods, slides, AO Spencer No. 73 Student Microscopes.

Each student will have a microscope and a single slide. The class is instructed to set up the microscopes to focus at low power of 100x (10x objective and 10x eyepiece) at any specks on the slide. The instructor can prepare the following materials at the demonstration table while the students are thus engaged.

Place a small erlenmeyer flask containing approximately 80ml. of a saturated copper sulphate solution and 5 grams excess solid on a tripod with gauze over a bunsen burner. Prepare similar flasks of alum and sodium chloride solutions. A clear solution of roll sulphur in 5 ml. of carbon disulphide is prepared in a stoppered test tube.

(CAUTION: Carbon disulphide is extremely inflammable. Do not heat the solution or place near open flame).

PROCEDURE:

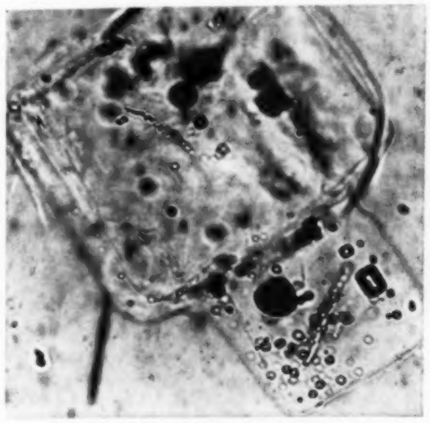
1. The students are directed to keep slide clamps off the stage and move the slide to the edge of stage. The microscope should not be tilted.

2. As soon as the copper sulphate solution starts to boil, the instructor picks up the flask with suitable means (pot holder or forceps) and, walks through the class placing a single drop of solution on each students' slide with a stirring rod.

3. The student immediately moves the slide under the objective and watches the drop, preferably at an edge, as it cools. Meanwhile, the instructor heats the second flask.

4. The procedure is repeated for the next salt solution, using a different spot on the same slide for comparison purposes.

5. After all burners have been extinguished, the instructor opens the sealed test tube and places a drop of cold carbon disulphide solution on each students' slide. From this, the student will observe sulphur crystals develop by evaporation.



Photomicrograph of sodium chloride crystal

OBJECTIVES:

1. The student is more impressed and usually more understanding of the basic concept of crystal formation and development. "He was there when it happened".

2. It demonstrates the process of crystal formation from solution by cooling.

3. It demonstrates the process of crystal formation from solution by evaporation.

4. Some idea of the many geometric crystals forms possible are graphically presented.

5. The student is exposed to a new and interesting field of study.

6. The term "precipitation" is meaningful and realistic.

This experiment can be performed with three substances in about twenty minutes with a class of thirty-five students. There is no difficulty in explaining the subject, performing the experiment, cleaning up for the next class and discussing the results in a forty minute period. Cleaning the slides is easily facilitated by passing a single facial tissue to each student.

Free 24 page booklet, "Elements of Optics", is yours for the asking. It offers a very practical way to introduce students to the fundamentals of color and light. The basic laws and theories of optics are clearly described and well illustrated. Get your copy of this 50 cent booklet, free. Just send your request to American Optical Company, Dept. J11 at address below. Ask for booklet number [illegible]. If you would like more information on the microscope used in this experiment, request brochure SBTI. There is no obligation, of course.

American Optical Company

Instrument Division • Buffalo 15, New York

Pharmacy Panel

(Continued from Page 69)

do not aspire to achieve the maximum of their potential ability. With these facts in mind, the following recommendations are made:

1. Secondary School classes be arranged as homogenously as possible (grouped according to interests, attitudes and ability in particular subject matter).
2. The student should be encouraged to do as much independent study as he is capable of doing in each of his classes.
3. The ability potential of the student should be recognized at as early an age as possible and educational guidance be initiated to help the student establish goals and generate enthusiasm.
4. Less emphasis should be placed on class standing by the colleges and professional schools.
5. There should be more contact between the secondary—schools, colleges, and professional schools for the purpose of exchanging ideas and developing a better mutual understanding.

IV Ability to Analyze and Solve Problems in Pharmaceutical Mathematics

The development of the whole individual is the principle objective of all levels of education. The elementary schools, colleges and universites, and the professional schools all play a prominent role in this development. Since the knowledge of certain fundamental concepts and the acquisition of certain skills must be a part of the whole individual if he is to take his place in a dynamic society, this knowledge and these skills must be taught effectively at all levels of instruction. Among the academic disciplines which contribute to the necessary knowledge and skills, mathematics holds a significant position.

Mathematics, pure and simple, is essential in every day living and its concepts and processes should be understood by all. The panel makes the following recommendations in regard to the arithmetical knowledge and skills which students should possess prior to entering the School of Pharmacy.

1. Students should understand the number system—the whole numbers, common fractions, decimal fractions, and percents—and how to manipulate them. This includes not only how to perform the four fundamental operations with these numbers, but also why the operations are performed. The digits, as place holders in the number system using the base ten, should be comprehended clearly and thoroughly. The student should also understand the metric system, logarithms, ratio, and proportion. It is stressed that emphasis be placed upon reasoning and understanding in order that the students may effectively think through the problems arising in pharmaceutical calculations. Once the student has analyzed the problem he must be able to perform the necessary mathematical operations for its completion. Hence, before entering the School of Pharmacy it is hoped that the students

are well on the way toward developing a scientific attitude and are thoroughly grounded in the operation of simple mathematics.

2. Since the nature of the mathematics needed by the pharmacist is peculiar to his profession, it is recommended that a formal course in pharmaceutical mathematics be offered in the School of Pharmacy and this course be taught by a member of the faculty of the School of Pharmacy. There should be allotted sufficient time for the effective presentation and thorough understanding of the material. Three lecture hours per week for one semester, with one hour devoted to recitation and discussion, should be sufficient. There should be a complete discussion of the apothecary system of measurement since it is still important in the work of the pharmacist. Since the proper utilization of mathematics by the pharmacist is of extreme importance in the compounding of prescriptions, the students training in the area should not be limited to the formal courses but practical applications should be included in the other professional areas.

If the above recommendations are incorporated in the teaching of mathematics in both the colleges and the professional schools, the panel feels certain that the students will find their work in pharmaceutical mathematics more profitable.

Analytical Nose

(Continued from Page 71)

peaks and valleys are called, can be read and calculated by technicians. But much faster results are obtained by using electronic readout equipment.

A digital computer, for example, can be connected to the Mass Spectrometer and programmed to automatically select up to forty peaks, and read the height of each one. Its readout can be in the form of typewritten data, punched tape, or IBM punched cards. These results in turn, can be fed to an electronic computer for fast, accurate solutions of the linear simultaneous equations.

Speed is a major advantage of the Mass Spectrometer; the whole process, from sorting the ions to counting them, is accomplished almost *instantaneously* through electronics! Refineries, chemical plants, aircraft companies, university labs, and many others, use Mass Spectrometers to analyze everything from hydrogen to heavy hydrocarbon oils.

Members of the Naval Research Laboratory have blasted mass spectrometers into outer space abroad Aerobee-Hi rockets to analyze the neutral gasses and ionic compostion of the upper atmosphere. The instrumentation for the three mass spectrometers abroad the Aerobee-Hi stands only 8½ feet high and weighs 165 pounds.

Bennett-type radio frequency mass spectrometers are used in these rockets because they're light, simple and do not require a magnet; the ions are separated according to their weight by a radio frequency.

Basically, the theory of the Bennett mass spec is this: Incoming ions are accelerated to an initial velocity. Then they go through a periodically varying field; the way the field is varied determines what weight ions will be given enough additional acceleration in the field to get them through a potential barrier to a collector plate. The ions that are not wanted, do not get enough acceleration in the r.f. field to get them through the potential barrier to the collector to be measured.

A spectrometer mounted on one side of the Aerobee-Hi, detects positive ions, while another spectrometer on the other side detects negative ions. As the rocket speeds through the ionosphere, ions are drawn directly into the tube and analyzed.

A third spectrometer, mounted on the top of the instrumentation, analyzes neutral gasses. Ions are created for it by bombarding the incoming neutral gas with electrons. This third spectrometer is calibrated, evacuated and sealed off before the rocket is launched. When it reaches the desired altitude, the seal is broken and the analysis begins. Analyses are made by the spectrometers every 1⅜ seconds. The results are radioed back to ground stations by a telemeter.

As rockets are developed to carry the instrumentation, mass spectrometers may be analyzing the atmosphere of the moon and other solar bodies in the near future.

New Books

Structure and Change

• *By* G. S. Christiansen and Paul H. Garrett. W. H. Freeman and Company. San Francisco, California. 1960. Pp. 640. $8.75

College courses in physical science for the liberal arts student tend to be oversimplified and uninteresting to the serious student. The authors of this textbook, by organizing their presentation around the concept matter, have produced a most interesting textbook and, by their insistence on basic principles, have avoided the pitfall of oversimplification. The subject matter is well within the capacity of the college freshman who studies, but will certainly cause the student who waits for the eve of a test much misery. The book is divided into three parts: the mechanical, the electrical, and the modern views of the world. It is well organized, basic concepts are stressed, and many fine illustrations contribute to the clarity of the text. In content, it is up-to-date, and the student who only reads it will find that he has acquired a sound appreciation for the present state of the physical sciences.

We recommend that you examine this book for yourself, for we feel that it cannot be adequately evaluated in a short review.

J.P.M.

The Search for Order

• *By* Cecil J. Schneer. Harper and Brothers. New York, N. Y. 1960. Pp. 384.

Sooner or later we will have to decide whether survey courses in biology, chemistry, and physics meet the needs of students majoring in the liberal arts. In view of the improvements in high school science teaching a new approach to the science requirement in liberal arts colleges may be in order.

The Search For Order is a study of the development and history of principle ideas in physical science, which can well serve as the basic text for a course in the history of science. Such a course would enable the college student who has had good science courses in high school to obtain a realistic and accurate appreciation of the development and nature of science. It would also help the science major in developing a better evaluation of the place and work of the scientist.

In addition to being a textbook, it is interestingly written, and it can be recommended to all who are interested in science.

J.P.M.

Saturday Science

• *By* The Scientists of Westinghouse Research Laboratories. *Edited by* Andrew Bluemle. E. P. Dutton and Company. New York, N. Y. 1960. Pp. 334. $5.94.

The scientists of the Westinghouse Research Laboratories conducted a science honors course on Saturdays for outstanding high school students. This book is made up of fourteen chapters written by the scientist-teachers of this course.

Each chapter is well written by an outstanding authority, and an interesting biography and picture of the author precedes each article. The result is a book that not only explains the fundamental principles and techniques of physics, but also presents an excellent picture of scientists as real people.

The printing and illustrations are of very high quality. The book can be recommended to the student interested in science and definitely belongs in the school library.

J.P.M.

An Approach to Natural Science

• *Edited by* D. H. Brehaut and B. E. Dawson. Methuen and Company, Ltd. London. Pp. 264. 8s.6d.

This is an introductory textbook in general science. It was prepared for use in an English school, but it could just as well be used in an American secondary school. Five authors have collaborated in preparing its fifteen chapters, but the editing is so well done that it is difficult to recognize it as the work of a group. In the preface the editors state: "We have interpreted the characteristics and mechanisms of living organisms in terms of the fundamental sciences of physics and chemistry in order to present a continuous course rather than one which is in effect 'biology-with-chemistry-with-physics'."

Teachers who are looking for a new approach to general science should examine this interesting book. We can also recommend it as a good book for the science teacher's reference shelf.

J.P.M.

Classical Mathematics

• *By* JOSEPH E. HOFMANN. The Philosophical Library, Inc. New York, N. Y. 1960. Pp. 160. $4.75.

"A Concise History of the Classical Era in Mathematics," is the sub-title of this book. It covers the High Baroque Period, the Late Baroque Period and the Age of Enlightenment (approximately 1625-1790). The author covers his subject matter well, and his presentation enables the reader to relate the development of mathematics to the developments simultaneously taking place in philosophy, literature, and science. However, he is too concise and only one well acquainted with the history and theory of mathematics can use it effectively. It is a good quick-reference book.

J.P.M.

Basic Concepts of Elementary Mathematics

• *By* WILLIAM L. SCHAAF. John Wiley and Sons, Inc. New York, N. Y. 1960. Pp. 386. $5.50

The author's purpose in preparing this textbook is to supply some of the mathematical background needed by teachers of elementary arithmetic. In view of the changes that are taking place in secondary mathematics and future changes that will certainly take place in elementary arithmetic, this book can be recommended not only as a textbook, but also as a reference book for those already teaching.

The author stresses basic principles of many of the concepts of arithmetic, logic, geometry, and algebra which are necessary for the teacher if she is to teach arithmetic effectively. It is interestingly presented, and, while its material is not too difficult, it does demand serious reading and study. It is in no sense a refresher or drill-book in arithmetic.

J.P.M.

Paper Back Editions

Harper Torchbooks— The Science Library

Seven new titles have been added to this excellent series.

The Skeleton Key of Mathematics by D. E. LITTLEWOOD (Pp. 138, $1.25) is a brief but excellent discussion of the concepts of modern alegbra which no teacher of mathematics can afford to neglect. At this price, we feel that it should be recommended to all college mathematics students as excellent outside reading. Another good book on the theory of numbers is **The Higher Arithmetic** by H. DAVENPORT (Pp. 172, $1.25). It is mathematically sound and clear in its presentation. While it is more difficult to read than Littlewood, it is still an excellent book for teachers of arithmetic, algebra, and trigonometry.

Biology teachers and college students interested in taxonomy, ecology, and evolution will find **Reptiles** by ANGUS d'A. BELLAIRS (Pp. 192, $1.35) and **Animal Species and Their Evolution** by A. J. CAIN (Pp. 190, $1.35) excellent works worthy of serious study. Biologists and philosophers interested in the historic controversy between mechanism and vitalism should read **Problems of Life** by LUDWIG VON BERTALANY (Pp. 216, $1.35) in which the author's organismic concept is presented.

Chemists and those interested in chemistry can obtain at a nominal cost the classics, **Chemistry in the Service of Man** by ALEXANDER FINDLAY (Pp. 318, $1.75) and **A Short History of Chemistry** by J. R. PARTINGTON (Pp. 416, $1.95), both well known books which have gone through many editions. Another interesting book for the chemistry student is **A Direct Entry to Organic Chemistry** by JOHN READ ($1.45).

J.P.M.

★ ★ ★ ★ ★

Atomic Weight of Silver Redetermined

The atomic weight of silver by accurately measuring silver's isotopic abundance ratio. The new atomic weight is 107.8731±0.0016 on the chemical scale and 107.9028±0.0011 on the physical scale, where the indicated uncertainties are over-all limits of error, based on 95 percent confidence limits for the mean, and allowances for effects of known sources of possible systematic error. The atomic weight of silver plays an important part in the determination of such fundamental constants as the faraday, Avogadro's number, and the gas constant. In addition, it is used to establish the atomic weights of many other elements on the chemical scale.

U. S. Dep't of Commerce Technical News

Life History

(Continued from Page 67)

complications may arise. The "do or die" spirit of the insect is shown in this case, and if it cannot rid itself of the exoskeleton, it tries until it dies.

By examining the shed exoskeleton one may obtain some knowledge of the external and the internal anatomy of the larva. Although most of the foregut and hindgut are resorbed before ecdysis, a thin layer of cells in tubular form is shed, attached to the exoskeleton, which preserves the outline of these parts. The spiracles and the inner chitinous lining of the tracheae can easily be seen, and there is a perfect cast of the mouth parts and the legs.

As a prepupa, the larva is fat and sluggish, and usually crawls to the surface. At its last molt it emerges as a pupa. *Tenebrio* forms no cocoon or other covering, so the pupal stage is also easy to study. The pupa is white, in contrast to the tan color of the larval stage, and is entirely enclosed in a thin membranous covering. Two pairs of typical beetle wing pads extend ventrally and the ommatidia begin to develop almost immediately. The pupa is quiet, but not completely so. It twists and turns its body periodically, and frequently flexes its abdomen. It moves in response to gentle probing during almost the whole pupal stage.

About 24 hours before emergence, the pupa begins to darken in color. The mandibles and the tips of the claws begin to tan, and the color gradually spreads to head, mouth parts, and the rest of the appendages, so that at the time of emergence these parts are quite dark. The membranous covering appears dry and darkens, and the pupa begins a rhythmic flexing of the abdomen. The mouth parts begin to move in a typical chewing motion, but the imago does not appear to chew its way out of the pupal case, as some have suggested. Rather, it seems to be ridding itself of the chitinous lining of the foregut. The split through which the adult emerges occurs dorsally in the head region.

The pronotum or thoracic shield turns brown almost immediately after emergence. The elytra or outer wings rapidly assume their natural position, and the membrous wings unfold gradually during the next fifteen minutes. At first the membranous wings appear much longer than the elytra, but they are soon pulled up under the outer wings.

Although the adults have two pairs of wings, they do not appear to use them in flight. Even if they are tossed into the air they make such feeble attempts to use their wings that it does not break their fall.

The exoskeleton of the newly emerged adult is soft and pliable, but after about 36 hours it has become hard and has taken on its characteristic black shiny appearance. Coloration proceeds by degrees, so that the various parts of the insect are uneven shades of brown until the final uniform black is attained. The head, mouth parts, and appendages are always a bit

darker than the pronotum, and the outer wings and ventral abdomen darken last. The dorsal abdomen under the wings remains white. Apparently, it also remains unsclerotized. During our studies, one wing of an adult was removed for examination, leaving the light dorsal part of the abdomen in that area unprotected. Two days later the traumatized insect consisted of head, thorax, and the other outer wing. The entire abdomen and the membranous wings had apparently been eaten by the others. The head and thorax remained alive and moved about in circles. There is also cannibalism among the larvae. Pupae must be put out of their reach, if the area in which they are confined is small.

Besides such gross observations as these, studies of the internal anatomy are readily carried out with *Tenebrio*. The larvae are large enough to be easily handled in dissection, and small enough to provide excellent practice in fine work. With the help of a dissection microscope, a few small instruments, and some dilute dyes, all the internal structures of the larva can be distinguished readily. The details of the technique have recently been published (5).

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Medical Schools

(*Continued from Page 75*)

in many years, coalesced into a dramatic suicidal attempt. He was hospitalized out of the city and eventually withdrew from school. Recovery has been essentially complete. He will return to medical school. The only question is whether it will be at Pitt or some other school.

4) Again a sophomore student—a 22 year old female with excellent high school, excellent university record both academically and in extracurricular activities. Her freshman work was solid. Midway of the second year, rapidly mounting anxiety occurred. Help was sought from the psychiatric department. Though her difficulties were serious an attempt was made to treat her while still keeping her in school. However, oppressively mounting guilt, terrifying feelings of inadequacy and a whole series of regressive symptoms related to a split religious upbringing made continuation impossible. Hospitalization outside the city was obtained. After several months of excellent therapy, she returned to her home. To all intents a cure was effected and we would have recommended readmission. This, in spite of the fact that part of her illness encompassed strong unconscious competitiveness with her father whom she was about to surpass in her fantasies. However, in this instance this student chose to resolve her problems by marriage to a classmate. The last time I saw them following his graduation, the marriage was an obvious success.

5) Finally an especially complicated situation. This was an older man (32) with a rather spotty undergraduate record. However, he had a solid record in obtaining an M. Sc. and a Ph. D. at two separate universities. His work was described as sound. His MCAT was 66—45—58—49. Almost from the start, his work in medical school, though in the especial area of his Ph. D. was abyssmally failing. After one semester, he was advised to withdraw which he eventually did. One can only guess at the reasons for his failure, but I think in this instance the guesses are solidly in the correct direction. When interviewed, it was clear that though superficially he denied it, he projected his difficulties on to others and he was fundamentally a hostile man, thorny to get along with, provocative beyond all doubt. In spite of this, he had clearly had every possible chance for help. This, it seemed to me, had been rather arrogantly refused. Clearly too, from his story, he had alienated himself from that excellent support classmates usually give each other. Perhaps in this instance we might have been warned of difficulty as in the interview his "sensitivity" was noted. In this student's case perhaps failure was the best outcome.

This presentation has made no attempt to be inclusive of all factors involved. However, it was aimed to be broad enough on the one hand and specific enough on the other to stimulate thought, questions and discussion.

Kitt Peak National Observatory

The Kitt Peak National Observatory near Tucson, Arizona, was dedicated Tuesday, March 15.

The dedication marked the opening of an optical observatory that will be available to all qualified U. S. astronomers. It is the equivalent for optical astronomy of the National Radio Astronomy Observatory at Green Bank, West Virginia, the other national observatory maintained by the National Science Foundation.

The first major telescope to go into operation at Kitt Peak will be the 36-inch reflector that has just been installed. Not large by modern standards, it is nevertheless of advanced design for use primarily as a photoelectric instrument for measuring star brightness. It will be the forerunner of an 84-inch reflector to be completed in 1961 or 1962.

The mirror blank for the 84-inch reflector has recently been delivered to the observatory from Corning Glass Works, Corning, N. Y. Final grinding and polishing are being done by the observatory staff.

Experimental design of a large orbital (satellite) telescope is perhaps the most dramatic project now under way at the observatory. This project looks beyond the specialized, smaller orbital telescopes now being planned by other observatories, and is intended to be an accurately pointable instrument of high resolving power that can make observations on command from earth and communicate them back to earth. A 50-inch aperture is presently being considered.

The orbital telescope is a long-range project, and it is expected that such a large, fully controllable instrument will not be placed in orbit for several years. The project is under the Kitt Peak National Observatory both because the size of the effort would probably exceed the capacity of a single university and because it is hoped that, once such a telescope is put in orbit, it will be a part of the observatory's regular instrumentation and would be available, as are its other telescopes, to all qualified U. S. astronomers.

The National Science Foundation and the Observatory are cooperating with the National Aeronautics and Space Administration at all stages of planning and design of the instrument. Close coordination with NASA's program of astronomy in space is being maintained.

Also being planned is a new solar telescope that will be the world's largest and that will have a specially designed building to house it. This instrument will have a parabolic mirror 60 inches in diameter with a focal length of 300 feet, producing a solar image several times larger and more brightly illuminated than that attainable by any other ground-based solar instrument.

Present for the dedication ceremonies on Kitt Peak were prominent scientists and officials of the Federal, State, and local governments, and representatives of the Papago Indian Tribe on whose reservation the observatory is located. Guests included the National Science

Board as well as the Board of the Association of Universities for Research in Astronomy, Inc. (AURA), which operates the observatory for NSF.

The National Science Board and the AURA Board held their respective business meetings in Tucson prior to the dedication.

The dedicatory address was given by Dr. W. W. Morgan of Yerkes Observatory. Dr. Waterman, KPNO Director Dr. Aden B. Meinel, Dr. R. R. McMath of AURA, and other guests also gave brief addresses. Dr. C. D. Shane of Lick Observatory and President of AURA presided.

The program began at 11 a.m. on Kitt Peak, and was followed by luncheon and a tour of the mountain facility for guests.

Selection of Kitt Peak for the site of the new observatory was announced by the National Science Foundation on March 14, 1958, following intensive site studies. One of the sacred peaks of the Papago Indians, the mountain has been leased by them to NSF for the observatory. In addition to payment for this right, the Foundation has also agreed that the Indians will have the right to use space on the site for sale of their arts and crafts. The Papagos are noted for their basket-weaving, done with the fibers of desert plants.

Appointment of Dr. Aden B. Meinel as Director of

the observatory was announced by the Foundation on Jan. 30, 1958. He was formerly with the Department of Astrophysics of the University of Chicago, and was an associate director of the Yerkes and McDonald Observatories. Among his specialties is optical design, and he has been a recipient of the Lomb prize of the Optical Society of America and of the Helen Warner award of the American Astronomical Society.

Member universities of AURA now include California, Chicago, Harvard, Indiana, Michigan, Ohio State, Princeton, Wisconsin and Yale.

★ ★ ★ ★ ★

Standard Oil Film Library

The entire public relations film library of Standard Oil Company (Indiana) is now being distributed throughout the mid-west by Ideal Pictures, it was announced recently by Paul Foght, Ideal's president. A total of nineteen titles are available free to all school, church, club, and other non-theatrical audiences and television.

Six of the titles are part of Standard's Progress Through Science film series and are particularly well adapted for beginning chemistry and science teaching. *The Case of the Mysterious Partner* tells about catalysts, *The Case of the Slippery Character* explains greases, *The Case of the Versatile Ring* is on benzene and *The Case of the Well-Fixed Molecule* is on nitrogen. These films are kinescopes of Standard's Spotlight on Research programs produced at WTTW (Channel 11) in Chicago, and run between 19 and 21 minutes each.

Fire Magic is a 12½ minute color film of Dr. Llewellyn Heard's famous science show which was presented more than 1200 times before nearly half a million people prior to his death in 1957. The film establishes the fire triangle of fuel, oxygen, and kindling temperature. Accented with colorful flames and minor explosions, the film spectacularly explains many types of combustion, and how they are harnessed to perform useful tasks.

Gasoline's Amazing Molecules is 22½ minute animated colorful explanation of the research, refining, testing and safeguarding of motor fuel. A group of animated cartoon-like molecules dramatize cracking, polymerization, ultraforming, and engine knock. It is both entertaining and educational.

The Standard Oil film library includes a number of films of particular interest to agricultural groups. The titles of these films are *Farm Tractor Care*, *Farm Tractor Safety*, *Farm Petroleum Safety*, *Man on the Land*, and *4-H Tractor Trails*. The latter film tells how young men and women learn to get more work from their tractors at less cost from the 4-H Tractor Program.

Lubricating Oil Amazing Molecules and *The Why of Automobile Lubrication*, tell the story of the manufacture and use of oils and greases. *American Frontier* is a documentary drama of the discovery of oil in the Williston Basin in North Dakota. It shows how modern pioneering and a new industry affected this area. *The Story of Colonel Drake* is a Technicolor production telling the story of the drilling of the first successful oil well near Titusville, Pennsylvania. *The Promise and the Glory* is a colorful re-enactment of early American history. It portrays the hardships suffered by the Jamestown settlers in 1607, the political struggle for freedom at Williamsburg, the colonial capital of Virginia, and the battle at Yorktown which ended with the surrender of British troops to General George Washington.

Destination Earth is an animated 14 minute color fantasy showing life on a planet without oil, and dominated by a dictator who plans and provides for everything. It is humorous and entertaining, and shows how free men making individual choices of their work and their purchases making living better for all. *Midwest Holiday* is a 27 minute color travel film through the breath-taking scenic heart of America from the Michigan sand dunes to the Grand Tetons of Wyoming. A pleasant human story runs through the film and tells how American people living in the American way have a very special gift to share with the rest of the world. The film was a Freedom's Foundation Honor Medal winner.

★ ★ ★ ★ ★

American Institute of Biological Sciences Translation Program

The American Institute of Biological Sciences is currently translating and publishing seven Russian research journals in biology. These journals are translated with support from the National Science Foundation, which is eager that such information be more widely distributed to biologists throughout the world. It is hoped that this material will aid biologists in research, prevent duplication of work, give some idea of the work being done by Soviet scientists in the field of biology, and also bring about a better international understanding among scientists.

Because of the support of the National Science Foundation, the AIBS can offer these translations at a fraction of their publication cost, with even further price reduction to AIBS members and to academic and non-profit libraries. This reduction, the AIBS feels, places the translation within the reach of all biologists.

The journals currently being translated are: ***Doklady:*** Biological Sciences Section; ***Doklady:*** Botanical Sciences Section; ***Doklady:*** Biochemistry Section; ***Plant Physiology; Microbiology; Soviet Soil Science;*** and ***Entomological Review.***

In addition to its program of Russian Biological Journal translations, the AIBS has instituted a separate program of translation and publication of selected Russian Monographs in biology.

Additional information pertaining to this program may be obtained by writing to the American Institute of Biological Sciences, 2000 P Street, N. W., Washington 6, D. C., U. S. A.

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BASE... AND DRIVING MECHANISM Stability is assured by the massive, cast metal base—where deep sockets are provided for the flexible shaft which carries the discharge ball, and for the lucite cylinder which supports, and insulates, the discharge terminal.

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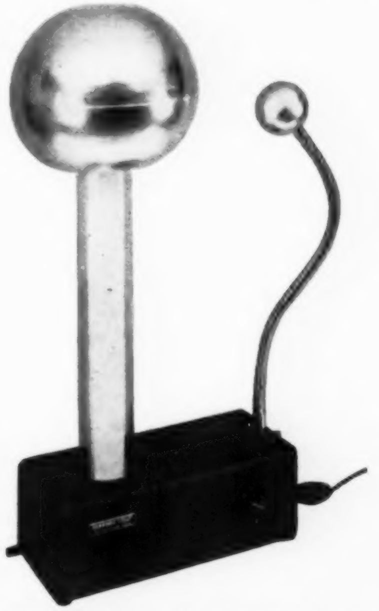

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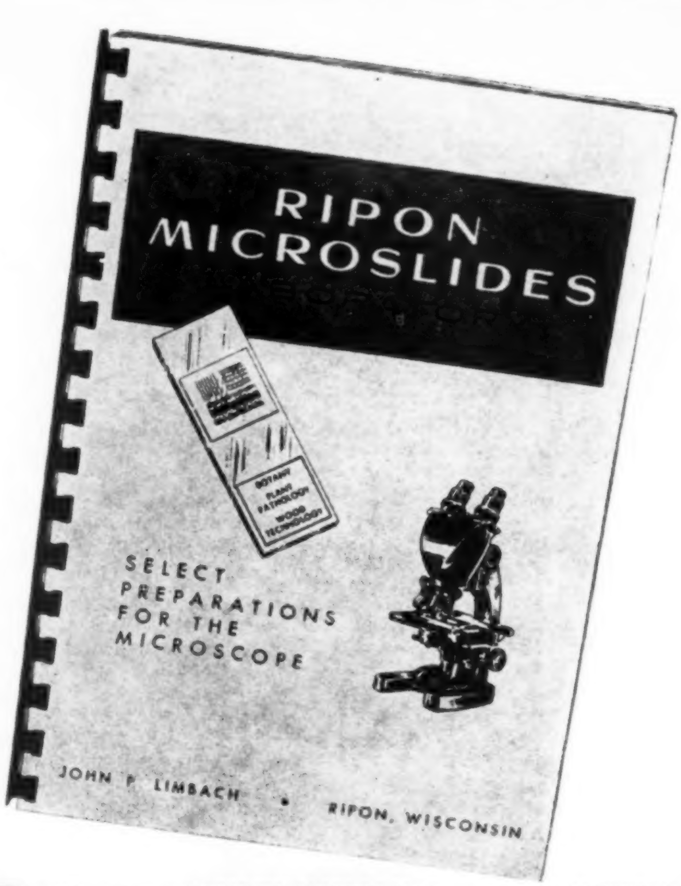

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